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Central Veterinary Laboratory, Weybridge, Surrey

Animal Health and Disease Prevention page 273

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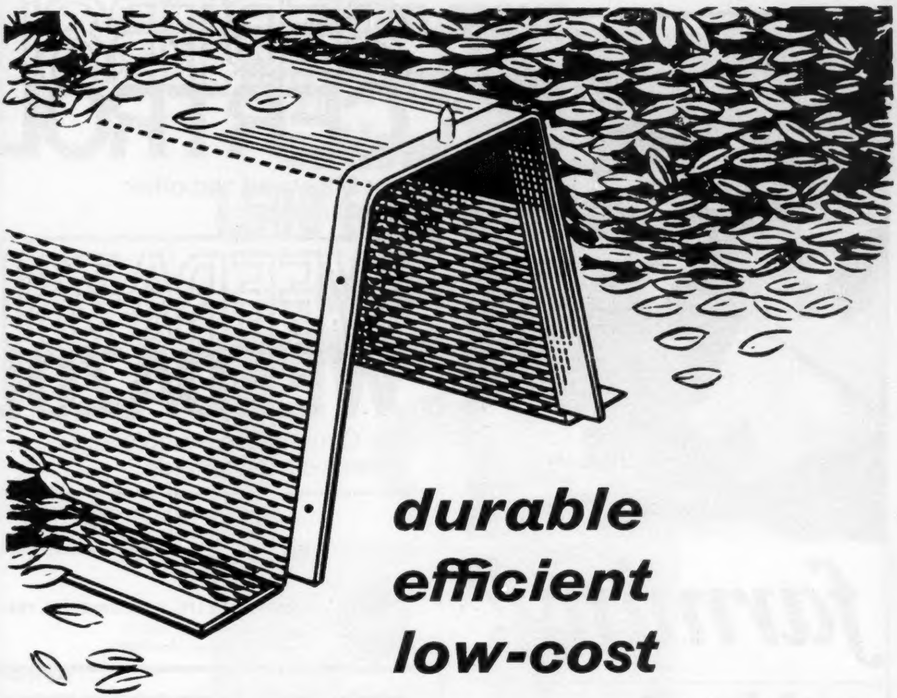

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Agriculture

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Contents

If you laid 958 farmers end to end they'd stretch from Lower to Upper Slaughter

—the 958 farmers who regularly prove that ICI fertilizers are right for your farm

Who are these 958 fármers and what do they know about *your* farm? They are the farmers who take part in ICI's Farm Management Scheme up and down the country. This scheme is based on an exchange of farming experience and know-how. ICI keeps a strict account of the management and costing of these farms and in return gains valuable practical knowledge of modern farming developments. Profitable use of ICI fertilizers at the right rate, at the right time, is a key factor in this. What's in it for you? Just this: out of 958 farms in the scheme, there are bound to be several that have problems and opportunities very similar to yours. Why not take advantage of the experience in profitable farming methods gained from this unique operation by contacting your local ICI representative for advice on your particular needs.

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Bags of farming experience

CENTRAL VETERINARY LABORATORY

..1917 ... GOLDEN JUBILEE CELEBRATION...1967..

DURING the week commencing 10th July, the Central Veterinary Laboratory at Weybridge will celebrate the 50th anniversary of its existence as the Ministry's main veterinary research institute. A search has failed to reveal the actual date in 1917 when the laboratories were first occupied and the week chosen for the celebrations has been selected to accommodate many distinguished scientists from overseas who will be attending the World Veterinary Congress in Paris in the following week.

The main feature of the celebrations will be two Open Days on Tuesday and Wednesday, 11th and 12th July, to which leading personalities in the fields of veterinary and medical science and agriculture have been invited. It is expected that the Minister will be present on the first day. On Thursday, 13th July, the laboratories will be open to friends and relatives of members of the staff.

Because of its special position within Animal Health Division of the Ministry of Agriculture, Fisheries and Food, the work at the Laboratory covers a wider range of activities than is usual in a research laboratory. It is responsible for the confirmatory diagnosis of scheduled diseases, other than foot-and-mouth disease, and for the production of biological products, such as tuberculin and *Br. abortus* vaccine, used for disease control schemes in which the Division has a direct interest.

The research programme is primarily devoted to the study of diseases of farm livestock which are of economic importance. This programme is liable to interruptions in order to deal with problems which may arise suddenly and unexpectedly; the outstanding examples in recent years have been the work on aflatoxicosis in farm livestock and fluoroacetamide poisoning in cattle.

The Laboratory is also active in the International field. The Biological Products and Standards Department is one of the three Biological Standards Laboratories of the World Health Organization and the Diseases of Breeding Department is a W.H.O./F.A.O. reference laboratory for Brucellosis. Training is given to research and technical staff from overseas, mainly from Africa, Asia and South America, and the Laboratory provides staff on secondment for development projects sponsored by the Ministry of Overseas Development and the Food and Agriculture Organization of the United Nations.

Climate and Disease

L. P. Smith
Meteorological Office, Bracknell

C. B. Ollerenshaw
Central Veterinary Laboratory, Weybridge

Recent developments in forecasting the incidence of four livestock diseases in Britain

THE great variable in many farm operations is the weather. To a large extent it determines the type of enterprise carried out in a particular area and, perhaps even more important, its profitability. The hay crop is dependent both in quality and quantity on the distribution of rain in early summer. The acreage of winter wheat and barley often depends on the ease with which autumn cultivations can be carried out. Rainfall again is the all-important factor. Thanks to the combine, the actual harvesting of the cereal crop is now less dependent than it used to be on the weather, yet yield, quality and the cost of harvesting are still directly related to climate. The importance of weather in this way is readily appreciated by all concerned in agriculture.

Climate and livestock

Until recently, however, there has been little interest in the importance of climate with regard to livestock. The increased cost of wintering hill sheep away and the need to increase stocking rates has given fresh impetus to methods of housing sheep. This has given prominence to the work at the Hannah Research Institute on the direct effects of weather on the well-being of livestock. That the health of livestock may also depend on climate, though often implied, seems to have received little detailed attention. Records of the incidence of a number of diseases show both seasonal and annual fluctuations. There is no doubt that variations in climate are responsible for some of these movements. It would seem to be a field of study which would well repay investigation, not only because such study may ultimately lead to fundamental discoveries, but because empirical relationships may be revealed and these can be used to forecast the incidence of disease. The ability to give adequate warning of the occurrence and—equally important—the absence of certain diseases may make an important practical contribution to their control.

As part of a continuing research programme, workers at the Veterinary Laboratory, Weybridge and the Meteorological Office, Bracknell, are examining a number of diseases with a view to discerning possible relationships with the weather. Where relationships are established and forecasts

of disease incidence issued, it is important for farmers to know something about these. In the course of time they can then observe for themselves the effects of weather on the incidence of these diseases. In this way, confidence in the accuracy of forecasts can be developed. It is also necessary to recognize the limitations in any system of forecasting. Variables other than the weather, such as the type of land, management, rates of stocking and variations in disease control also play a part; disease problems are, therefore, not identical throughout the country. Until all aspects of any particular disease are thoroughly understood, forecasts of incidence are likely to indicate only the broad trends. It is up to the stockman to interpret these broad trends in the light of his own experience and to decide on appropriate action.

Fascioliasis

The association between liver fluke disease and weather was an obvious first choice for study. Outbreaks had long been associated with wet summers, the classic example occurring in 1879 when some 3,000,000 sheep died. That summer was the wettest on record. Since then at irregular intervals, serious epidemics affecting large areas of England and Wales have been experienced, the most recent being in 1958.

The life history of the liver fluke is complex. Adult flukes lay thousands of eggs which pass on to the pastures in the dung of infected stock. If there is to be further development of this parasite the organism which hatches from the egg must in its limited free existence penetrate into one particular variety of snail. If it fails to find this snail it perishes. Inside the snail further development and reproduction occurs and eventually several hundred young flukes emerge to encyst on the herbage. Livestock are infected by eating this herbage. The snail involved in this life cycle is confined to badly-drained areas, shallow drainage ditches, overflows from springs and similar wet areas (the so-called flukey areas). The snail is rarely found on well-drained land or in permanent water. Since development of the whole life cycle of the fluke outside the final host is not possible in temperatures below 50°F (10°C), summer is the important season. In addition to an equable temperature, adequate moisture is indispensible if the parasite is to survive and develop. In wet summers flukey areas remain wet and may increase in area. Snails grow and multiply. These same wet conditions allow more fluke eggs to hatch and so more snails become parasitized. Thus at the end of wet summers there are more infected snails extending over greater areas of pasture and producing a greater weight of infection than following dry summers. Since the whole life cycle takes at least three months, wet conditions must be maintained for similar long periods before infection of stock is possible. One wet month in an otherwise dry summer is of little importance, as are isolated thunderstorms. It is the overall wetness of the whole period from May to October (when temperatures allow development) that counts and any measurement of this is likely to provide a useful estimate of the incidence of fluke disease in the following autumn and winter. Thus in spite of the apparent complexity of the life cycle, the basic relationship used in forecasting disease incidence is a simple one.

The first forecast was issued in 1958, a year of very high incidence. Fortunately there have been no further occasions when incidence was equally high. In 1963, 1965 and 1966 it was above average. In all these years full control measures were recommended. In the remaining years except one, incidence was about average, sometimes slightly above, sometimes

below. The exception was in 1959, a year with a spectacularly dry summer and in consequence a particularly fluke-free year. A comparison between the forecasts and subsequent incidence for these years shows that the forecasts were reasonably accurate, though errors of detail were made.

Nematodiriasis

Nematodiriasis is a worm disease of young lambs which sprang into prominence in the early 1950s. At this time there was no drug capable of giving control. Although several species of Nematodirus worms occur in Britain, one in particular, *Nematodirus battus*, is responsible for outbreaks in spring. The eggs are deposited on the pastures in the dung of infected lambs. The egg develops slowly and by September it contains an infective larva, yet hatching does not take place until much later, usually in the following spring. A number of workers have noted that incidence is high following cold winters and late springs, and low following mild winters and early springs. It has been suggested that cold winters and late springs delay the hatching of the egg. When hatching ultimately takes place, lambs are eating herbage and a high incidence ensues. Following mild winters and early springs hatching occurs early. The peak herbage infection is passed before lambs are eating quantities of herbage and this results in a low incidence of disease. Examination of records confirms the existence of a relationship between the onset of spring and the incidence of disease. In 1951, 1955, 1958, 1962 and 1963, all years with cold winters and late springs, incidence was high. In 1957 and 1961 when spring was early it was low. The one-foot earth temperatures in March at selected meteorological stations may be used to assess the onset of spring and a forecast can be based on these values. Such forecasts can be issued in early April well before the occurrence of disease. Two experimental forecasts have been issued; in 1965 when it was expected to be above average and in 1966 when below average incidence was forecast.

Swayback

Swayback is a nervous disorder of new-born and young lambs characterized by inco-ordination of movement. It is associated with copper deficiency in the pregnant ewe, though there is evidence that a low copper status alone does not necessarily cause swayback. Although lambs in certain areas are more prone to the disease than those elsewhere, incidence may vary widely from year to year. It is generally accepted to be more prevalent in springs following mild and open winters. Thus in 1957 and 1961—the low incidence years for nematodiriasis—the incidence of swayback was high. In 1964, following an open but not a mild winter incidence was even higher. On this evidence there is likely to be a relationship between incidence and the number of days with snow covering the ground. Certainly, following the very severe winter of 1963, it was the lowest on record. It might be claimed that the number of days with snow provides a measurement of the amount of supplementary food given to in-lamb ewes and it is the copper in this food which prevents swayback. There is much evidence, however, that this is not an adequate explanation. It is of interest to note that in parts of the country where snow-falls are rare, incidence tends to follow the trend for the whole country. Another observation which emerges from a com-

parison between incidence and snow cover is that the relationship seems to be invalid in the year immediately following a year of high incidence. It may be that in such years preventive measures are increased.

Unlike the forecast for nematodiriasis there is a real problem in having a forecast ready in time for preventive action to be taken. To some extent the problem can be solved by issuing two forecasts, a provisional one at the end of January and a final one a month later. If at the end of January the mean days with snow cover at selected meteorological stations is less than 8 then incidence is likely to be high or above average. If at the end of February the total is less than 10 it is likely to be high or if more than 10 above average. On the other hand if the number of days with snow is above 8 at the end of January incidence is unlikely to be high and in most years will be below average or low. If at the end of February the total is less than 20, incidence is likely to be above average. If more than 20 it is likely to be below average or low, and certainly low if the total exceeds 30. Where a provisional forecast at the end of January indicates the probability of above average or high incidence it is suggested that preventive action is taken during February, if that month is relatively free of snow, without waiting for the final forecast at the end of that month. Much, of course, depends on the time of lambing.

Since this relationship was established, incidence in 1965 and 1966 has been low or below average and no forecast was issued.

Parasitic gastro-enteritis in cattle

The most recent study of a possible relationship between disease and weather concerns parasitic gastro-enteritis in cattle. This disease is caused by a number of worms but *Ostertagia ostertagi* and *Cooperia oncophora* are the most important. Work at Weybridge has shown that herbage infections are usually low when stock is turned out in spring. Sometime in July there is an increase in infection and this increase continues usually until August. Thereafter the infection remains relatively constant throughout autumn and winter. It falls in early spring to a low level. This pattern of infection has been fairly consistent over a number of years, though the level of infection which is reached in August varies in different years. It is presumed that in years when this level is high more outbreaks of parasitic gastro-enteritis in late summer and autumn are encountered. Records of incidence over a number of years confirm that most outbreaks occur in late summer and autumn. A surprising feature of this study, however, revealed that in certain years outbreaks were prominent in early summer. In these early summer outbreaks deaths were more common than in outbreaks later in the year. Clearly, outbreaks occurring in early summer cannot be easily reconciled with the previously described pattern of herbage infection. A high incidence of disease in early summer was noted in 1956, 1960 and to a lesser extent in 1965. One common feature about these years was not that they had similar weather patterns, but that they followed years with late summers which were particularly dry (1955, 1959 and 1964). Work at Weybridge in the dry summer of 1959 had already shown that there was normal development of *Ostertagia* in the dung pat, but because of the dry weather the larvae were retained in the dung until the autumn rains. It seems possible that the occurrence of exceptionally dry summers interferes with the normal pattern of herbage infection in that year.

It seems possible that the occurrence of exceptionally dry summers interferes with the normal pattern of herbage infection in that year and that this influences the occurrence of disease in the following early summer.

Work in the University of Glasgow has in fact recognized two forms of the disease identified as types I and II. The former refers to the usual description of parasitic gastro-enteritis occurring from late July until the end of autumn in animals at grass. In type II, disease may arise any time from December until June. It was observed that larvae ingested by grazing animals in late autumn do not develop normally, but become inhibited in the wall of the stomach. Some time later these larvae may resume their development when the animals could become clinically affected and die. In south-west Scotland where these observations were made, the last outbreak was observed a week before the animals were turned out in June. Reports of disease from England and Wales in 1956, 1960, and 1965 suggest that most outbreaks occurred in May and June when the animals had been out to grass for some time.

In relating incidence to the weather consideration must be given to these two forms of the disease. Present indications are that the soil moisture deficit up to the end of July may be used to assess the incidence of type I disease. The lower the soil moisture deficit which implies a high, well-distributed rainfall, the higher the incidence appears to be. Type II disease depends on rainfall in the previous August to October. In this case, the lower the rainfall the higher is the incidence.

The state of knowledge

It will be appreciated that a precise knowledge of the underlying factors which lead to the relationships between weather and epidemic disease has not in all instances been attained. With liver fluke disease and nematodiriasis there exists a reasonable knowledge of the response of the parasite to varying climatic conditions. With parasitic gastro-enteritis the important factors are less well understood. Very much less is known with swayback and the relationship is, therefore, essentially empirical.

Having regard to the gaps in our fundamental knowledge of the diseases and the manifest complexity of the situation the correlation between records of disease incidence over the past 10–15 years and weather conditions have proved surprisingly good. On the evidence, reasonably reliable forecasts of incidence of swayback and parasitic gastro-enteritis could now be issued as well as the forecasts currently being issued for liver fluke disease and nematodiriasis. The publication of such forecasts might of itself lead to the provision of more information on disease incidence and as a consequence to an improvement in the accuracy of the forecasts.

A further article on Animal Health and Disease Prevention will be published in the July issue of *Agriculture*

Hardboard Buildings

Why not?

Peter G. M. Riding

A VISITOR to Sweden cannot but be impressed by the aesthetic and functional features of some of its new civic and commercial buildings as well as many of its houses and bungalows. It is not until the inquisitive eye looks closely that it is realized that many of the new houses and bungalows, and even some low-rise flats, have external wall facings as well as internal wall partitions and linings made of hardboard. In rural areas too the use of timber and hardboard in new farm buildings is widespread. Being a country which is half covered with forest it is small wonder that it should have fully exploited its trees over the years which has led to the extensive development of forest products in the form of hardboard for building.

Types of hardboard

To the layman hardboard is a near relation to cardboard and thus may be thought to be unsuitable for use in farm buildings, other than perhaps for ceiling linings where high humidity and condensation problems are non-existent and strength of material is unimportant. In fact, nothing could be further from the truth. Most varieties of compressed wood fibreboard are loosely described as hardboard but this covers a wide variety of products. In an article such as this the technicalities of hardboard production cannot

Large piggery in Sweden with walls clad entirely with medium quality hardboard

be examined and it will suffice to remember that a wide choice of fibre building boards which have varying densities are available under four broad categories. For example, standard hardboard has a density exceeding 55 lb per cu. ft; oil-tempered hardboard is denser than this and thus more durable, because it has been treated during manufacture to give increased resistance to water absorption and has a higher breaking strength than standard hardboard. Medium hardboard (panel board) has a lower density than standard hardboard but as well as being available in sheets $\frac{1}{4}$ in. thick it is more usual for it to be used over a range of thicknesses up to $\frac{3}{4}$ in., which give a very rigid surface in use. Insulating board $\frac{1}{2}$–1 in. thick has a density less than 25 lb per cu. ft and is consequently not as robust as other hardboards. Boards are available in a wide range of sheet sizes and thicknesses but 4 ft is a fairly standard width, with lengths varying from 6 to 12 ft. Thickness of sheets varies, there being ranges within each of the categories of board.

Uses for hardboard in Sweden

Oil-tempered board is tough and capable of withstanding the demands placed upon it by stock, including a fair degree of resistance to possible physical damage. For years it has been used in Sweden for pen divisions and internal wall linings in piggeries, as well as for retaining walls in bulk grain stores. Painting is unnecessary but in the interests of hygiene and to assist cleaning down it is invariably fixed with the smooth side visible. For pen division walls in fattening piggeries $\frac{5}{16}$ in. boards 3 ft high, secured by dropping the sheet into a $\frac{3}{4} \times \frac{3}{4}$ in. groove of bituminous mastic in the concrete floor, have been found satisfactory. For stability the top of the sheets can be let into a groove in a $4\frac{1}{2} \times 1\frac{1}{2}$ in. softwood rail. Butt jointing of sheets with two galvanized washered nuts and bolts make for simple and effective fixing. Oil-tempered hardboard is used here because of its superior strength properties, its improved water resistance and its resistance to chemical attack. A one foot wide light timber and hardboard catwalk, which can be used for inspection and hand feeding if required, gives rigidity to the divisions. This is all very simple and does not call for the employment of specialist tradesmen, an important consideration in Sweden where the number of country builders is declining.

Although oil-tempered board for roofing has been used experimentally without treatment, painting, felt or other covering, its use for this purpose is not recommended at present. Standard hardboard does not have quite the same density as oil-tempered board so is not usually selected for purposes making such exacting demands.

Medium hardboard (panel board), although less dense than oil-tempered or standard board, has been used extensively in Sweden in sheets $\frac{1}{2}$–$\frac{3}{4}$ in. thick over recent years for external as well as internal wall linings for dwelling houses and buildings with the screen side exposed. This gives a canvas texture and a most attractive finish when coloured with suitable flat paint. External vertical joints are invariably covered with (say) $1\frac{1}{2} \times \frac{3}{4}$ in. timber battens, which can also be used on intermediate timber studding to give a building an enhanced appearance. Alternatively, vertical grooves are sometimes ploughed with a plane over intermediate studding, in which case concealed nailing would be used. Such methods bring relief to a flat sheet, particularly in the case of small buildings. For variety, medium hardboard sheets cut to widths of about 12 in. permit fixing on horizontal

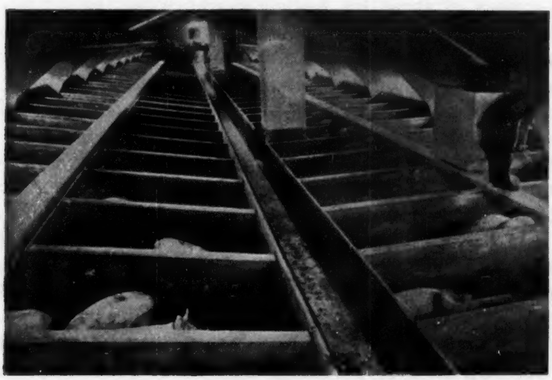
timber tilting fillets which give a pleasing weather-board type finish. Care is, however, taken to ensure that the bottom of all sheets used externally are clear of the ground by oversailing the concrete foundations, which allows the sheets to dry out.

Insulation board, being relatively soft, is not normally recommended for use other than as internal linings where physical damage is not anticipated. Even so ½ in. thick bitumen bonded insulation board used as an external wall lining on a piggery for five years seems perfectly satisfactory.

Constructional methods in Sweden

Whether traditional or prefabricated construction is used, the normal practice is to provide a bituminous damp-proof course to secure walls against rising damp. Bearing in mind that temperatures of minus 30°C can be expected for prolonged periods, particular attention to insulation is all-important. Standardized prefabricated building shells are built up by box wall panels. Normally 8 × 4 ft sheets are used for internal and external cladding and these are built up on 4 × 2 in. or 6 × 1½ in. softwood frames depending upon the amount of insulation to be provided. The former is more usual for stock buildings providing load bearing or curtain walling as required and incorporating 4 in. of vapour-sealed mineral or glass wool wrapped in polythene bags. Farm roofs are sheeted with corrugated asbestos cement or aluminium carried on either portal frames or light-weight lattice timber trusses in five standard widths with spans up to 45 ft. Insulation is fixed under the purlins or at eaves level supported by a hardboard ceiling secured to the underside of trusses. In either case prefabrication is possible to carry the amount of insulation required, while care is taken to ensure that the vapour barrier is complete with mastic or tape sealing of joints.

Proper ventilation is as ever all-important and natural or mechanical devices designed for the purpose are incorporated.



Tempered hardboard (⅛ in.) *partition walls with timber passage over dung channel in fattening house*

Application in Britain

Much has been said in recent years about farm buildings being too permanent and that they become obsolescent long before they are worn out because of the speed of technological change. One of the problems is that no real answer has yet been found to the way in which light, less expensive buildings can be provided which give satisfactory environmental

conditions for stock, crops, machinery and, of course, the farm worker, and at the same time are capable of being readily altered to meet new demands. The stability required for safety alone calls for a sound structure whatever the useful life of the building. Possibly a way out of the problem is to adopt design features which permit adaptability to lessen the risk of obsolescence.

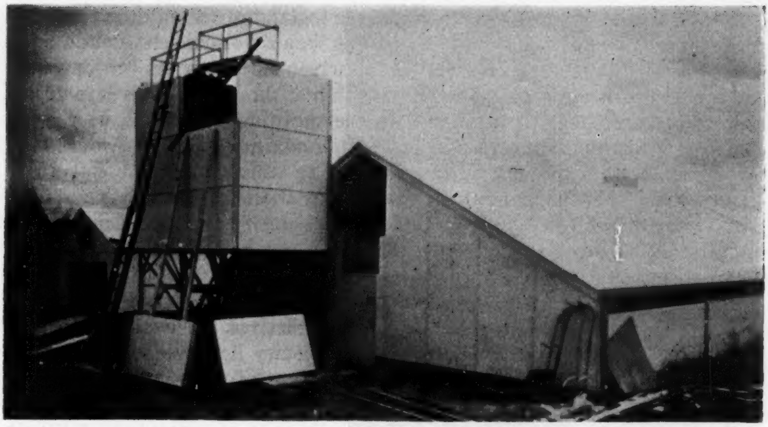
It is here that hardboard may be able to play an increasingly important role. Although currently some 1,000 m. sq. ft of fibre boarding are used here annually, comparatively little of it is believed to find its way into farm buildings. This seems strange bearing in mind that it was invented in Britain at the end of the last century and that it has become an acceptable building material on farms in Sweden where conditions are far more severe in winter.

If on the basis of Swedish experience a greater use is to be made of hardboard in our farm buildings, the importance of selecting the right type for the particular job cannot be over-emphasized. The use of unprotected hardboard for external roof sheeting is not yet recommended but as tempered board has now been accepted as a suitable material for external wall cladding under the Building Regulations, 1965, there is obviously a place for it for such purposes on the farm. Already complete prefabricated cattle yard kits using only tempered board for the walls on 4×2 in. timber box frames are available. There is renewed interest in space boarding for cattle yards, which, like Yorkshire boarding on roofs, can give a good environment with adequate ventilation, free from draughts, at the same time overcoming many condensation problems. As slotted tempered hardboard is now produced which gives about 25 per cent space for the free passage of air, this must surely have distinct possibilities for wall cladding in naturally ventilated uninsulated buildings for adult stock in the form of cattle or sow yards, while perforated board (pegboard) in the same quality might also be used.

Sheep are traditionally extensive ranging animals but economic pressures are leading to renewed interest in housing both ewes and lambs. It is well known that the advantages of sheds for hogg and ewe wintering quickly become financially unattractive unless the cost of buildings can be kept to a minimum. Whether this leads to the adaptation of existing buildings or the provision of new sheds hardboard can have an important part to play, for plain and slotted tempered board is very suitable for single skin wall cladding.

In pig and poultry buildings hardboard correctly used has been incorporated in a number of designs for several years and has proved to be quite satisfactory. It must be remembered that in addition to physical pressures from stock internal surfaces should be smooth and free from cracks and crevices which can provide a home for parasites and disease producing bacteria. Such buildings can withstand being disinfected and fumigated periodically.

General purpose buildings, implement and packing sheds are still built on traditional lines, but with the ever-increasing demand for such buildings to be adaptable, dry methods of construction must gain ground. Retaining walls and partitions for bulk storage of grain and other crops can within limits incorporate tempered board. Equally it has been used satisfactorily over recent years in Scandinavia for lining fodder ensilage clamps even in the open. Should it be found that its life in Britain is limited to only a few years its low cost permits renewal because its smooth surface ensures good consolidation and it reduces wastage to a minimum for this type of silo.



Prefabricated hardboard piggery weighing under 20 tons with hardboard clad meal bin for 1,000 baconers

On most farms small mass concreting jobs are constantly being carried out which call for simple shuttering and here again what better material than tempered board for lining form work to give a top class finish?

With the availability of prefabricated grain drying and storage bins few farmers may think of building their own but there really is no reason why tempered board should not be used to convert, say, an old stable with an adequately supported loft into a grain drying and storage unit. The main duct and holding bins could be in tempered board, while the drying floor could even be of tempered perforated board supported on, say, 6 × 1 in. timbers set on edge at about 6 in. centres to provide the plenum chamber. Any proposals to extend grain storage to loft floors should only be proceeded with after seeking expert advice, particularly as many of them were never designed to carry the weights involved. There is no reason why hardboard should not be used for a host of fixed equipment and other items around the farm. The use of hardboard for internal wall and ceiling linings readily come to mind while flush doors, hay-racks and mangers, bins, hoppers and chutes are but a few of the other possibilities. Naturally joints must be sealed with a suitable mastic compound but unlike most timber used on farms, hardboard does not shrink to any serious degree. Insulation board as well as being used above ground can also be used by covering with a concrete screed when laying new concrete floors, but naturally it must be kept dry, to retain its insulating properties. This can be done by wrapping it in polythene sheeting.

Handling and fixing

In this short article it is possible to mention only the more important directions that should be followed when using hardboard. A suitable damp-proof course is essential whether traditional or prefabricated methods are followed. Although temperatures experienced in this country are unlikely to fall as low as minus 30°C as in Sweden, insulation of buildings is becoming more important. Prefabricated box wall panels, load bearing if required, using the normal 8 × 4 ft sheets for internal and external cladding, built up on 4 × 2 in. softwood frames, could be used as in Sweden to provide insulation as necessary.

To get the best out of hardboard simple instructions should be followed. Oil-tempered and standard fibre building boards should be conditioned before use by damping each sheet on the screen side 24 hours before fixing, while water-resistant boards should be left up to three days. This is to adjust the moisture content of the board to the moisture conditions which will exist when the building is in use. Without conditioning, boards would take up moisture from the atmosphere after fixing which might cause them to swell or buckle. Proper conditioning will ensure sheets being smooth and taut. Hardboard which has buckled is unfortunately seen all too frequently when used by the amateur and indicates that it has not been fixed in accordance with the manufacturer's instructions.

Flat-headed galvanized nails should penetrate not less than ½ in. into the joists or battens. If required impact type adhesives are available for use instead of nailing, while a number of proprietary lightweight metal fixing systems have been developed to provide a means of fixing board linings to steel frame structures.

As farm fires are still all too numerous in spite of precautions taken to avert them, it should be remembered that both hardboard and fibre insulating board are readily available with a Class 1 spread of flame rating when tested to B.S.476 and this type complies with current Building Regulations.

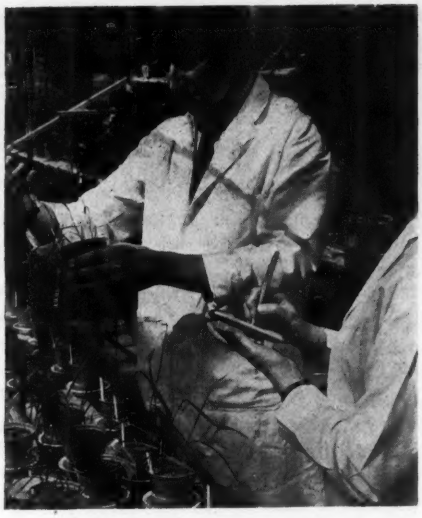
Conclusions

As is well known the cost of providing buildings is an important factor to take into account in assessing the profitability of individual farm enterprises. The fact that there is criticism that our present buildings are too expensive, too permanent and too difficult to adapt to modern requirements demands that consideration should be given to the use of cheaper forms of material. Hardboard, which is cheap, light, tough and versatile may well give the answer provided the right type of board is selected and careful attention is paid to its fixing. There is certainly no reason why economy in building costs by the use of such material should be at the expense of aesthetic considerations. Provided amenity aspects are respected and thought is given to the conservation of landscape, the imaginative use of oil-tempered and slotted hardboard can give pleasing effects and certainly need not lead to ugly buildings.

The age of instant housing for man, for example in the form of residential caravans which make extensive use of hardboard is already a reality. Surely this trend will spread to farm buildings. In fact, the day of the package deal prefabricated grain store, cow kennel and milking parlour is already with us. If this trend spreads throughout the whole range of farm buildings then the use of the various forms of hardboard must surely gain in popularity as providing a durable, light, cheap and adaptable material for prefabrication in flexible building systems.

The author of this article, Peter G. M. Riding, F.L.A.S., is Regional Land Commissioner at Headquarters in London. He was previously Divisional Land Commissioner for the West Riding of Yorkshire and, prior to that, Land Agent to the Worcestershire County Agricultural Executive Committee.

Pesticides are given preliminary tests under controlled conditions in the glasshouse



From Laboratory to Farm

The Development of Agricultural Pesticides

E. A. Riley

How many of us, I wonder, stop to consider what lies behind agricultural pesticides—how they are developed and the hurdles they take before they reach the market? Their story is sometimes exciting, often frustrating and always expensive. Estimates of development costs vary but are now reckoned to be not less than £½ million for each new chemical brought into successful use. This represents a large outlay indeed and one which needs the most careful consideration before a decision is taken to develop a promising chemical.

Finding new chemicals

A typical story might start in the laboratories of one of the large chemical manufacturers. Every year, several thousands of new chemicals are made or 'synthesized' by the chemists, and the biologists working in the same laboratories will try these, or a large number of them, for their biological effects. To use the technical term—these chemicals will be 'screened'. In the first instance, they will be tested against certain fungi, insects, weeds and other pest groups such as eelworms and molluscs (which includes slugs and snails) to see if they act as fungicides, insecticides, weed-killers, nematicides or moluscicides. At this stage no attempt is necessarily made to try the chemicals against economically important pests, though often near relatives which can be reared or cultivated easily are used, simply to see whether they have properties that could be exploited. Of the several thousand compounds

tested, it is unlikely that more than a few will show promise and of these perhaps only one or two may become marketable. This process of screening is a continuous one but it is to a large extent a 'hit and miss' method of selection. In the course of time, however, certain groups of similar chemicals may be found that show desirable properties and in this event the chemists will make modifications to their molecular structure, sometimes adding, sometimes subtracting pieces from them, thus providing a series of variations on a basic theme. These variations will be further tested by the biologists and improvements to the original discovery may sometimes be obtained in this way. This is a more positive approach to the selection of potentially useful chemicals.

The preliminary tests are designed to indicate whether an insecticidal or fungicidal chemical acts directly, or whether it is taken up by the plant through the leaves or roots to become distributed through the sap or 'systemic'. Weed-killers will be tested for their action through the foliage or through the soil.

If a chemical is sufficiently promising at this stage a preliminary assessment is made of its toxic properties. Provided the chemical is not too toxic, small scale field tests are begun, dosage rates are worked out and, if the original promise is maintained, applications for patents will be filed.

Field testing

Pesticide chemicals as they come from the laboratory are rarely suitable for use as such and need to be mixed or 'formulated' with solvents or fillers and wetting agents. The formulation of compounds in a form suitable for use in the field is a vital step in development. Formulation can make or break an otherwise promising material and before larger scale tests can be undertaken in the field, the formulation chemists will prepare a number of different formulations to see how they behave. In addition, to having suitable biological properties the formulated chemical must be stable in storage and its physical properties must be retained under the varying conditions of heat, cold, damp, etc., that it will meet in transit or on the farm. It must also mix satisfactorily with different types of water if it is to be used in this way. For example, wettable powders must remain in suspension in the spray tank and emulsions must not separate into their constituent parts when left to stand.

The next stage is the evaluation of the formulated chemical under as wide a range of conditions of soil and climate as possible. Because of the high development costs and the necessity of using limited staff resources to the best advantage, initial development is usually directed towards solving a problem or problems in particular crops. Economics usually determine whether the chosen crop will stand the cost of pesticide treatment and will be of large enough acreage to ensure a large scale use of the product when it reaches the market.

The detailed field trials carried out under a wide variety of conditions are usually statistically designed; that is, each of the experimental treatments is repeated several times in small plots arranged at random over the test area. Other plots in the area will be given standard treatments or no treatment at all and will be distributed at random among the treated plots. Thus factors such as soil variation and the position of plots relative to each other which could bias the results are evened out. As many as a hundred such experiments may be carried out at different places during development

and detailed records are taken during the growing season. Not only must the effect of the chemical on pests, diseases and weeds be taken into account, but also the effect on the crop itself. Gross damage may follow chemical treatment or yields may be depressed and the experiments must be so designed as to produce information on these aspects also. If damage does occur, an alteration to the formulation may be all that is needed but sometimes it precludes altogether the use of a chemical on certain crops.

Tests for safety

While the field trials are in progress, a more critical examination is made of the toxicology of the new chemical. Toxicity must be determined by various routes, for example, by mouth, through the skin by absorption, or by injection. Rats are usually used for this work and the first assessment is likely to be what is termed the acute oral LD50 dose or the single dose taken by mouth which will kill 50 per cent of a batch of test animals. This is usually quoted in milligrams per kilogram of body weight. Having established this dose, further experiments will be done using lower doses and longer periods of exposure. Long-term feeding of the chemical in the diet may be carried out for up to three months to determine the effect of ingesting small but continuous doses. Records will be made of the weight of the animals, their food intake and behaviour, and post-mortem examinations will be made to see if there have been any changes to the internal organs. The results of these tests will suggest whether even longer-term tests are needed and in some instances these may last as long as two years and will include observations of the potential 'cancer-producing' effects, if any, and also the effect on reproduction.

The results of the study on rats may not be typical for mammals in general and the toxicity to other mammal species such as mice, guinea pigs and rabbits as well as to birds and fish must also be determined. The actual mechanism of toxic action must also be worked out and antidotes investigated for use in cases of accidental poisoning.

A field experiment showing plots in a weed-killer trial. Weedy, untreated plots can be clearly seen

A further important aspect that must be considered is the amount of residue that the formulated product will leave on treated crops that will go for human or animal consumption. These residues are of a very small order indeed and are measured in parts per million (ppm) by weight of the produce. Extremely refined techniques are needed to measure such small amounts and each new group of chemicals will probably require a new method to be developed for it. Residues are measured from the time a product is applied to a crop and followed through to harvest and the progress of decline of the residue is plotted as a 'decay curve'. It may be necessary to 'tag' the product with a radioactive tracer to follow its path through the plant and to assist in finding out if the residue is that of the chemical applied or its breakdown products. If the breakdown products are different from the parent chemical it may be necessary to carry out more studies to find out whether, and if so, how toxic they are.

All these studies will have been in vain if the chemical cannot be manufactured economically and on a suitable scale. The laboratory process of manufacture will need to be translated to that of a pilot plant and finally to a full-scale plant before a product can be produced for sale. Suitable methods of analysis for the active chemical in the formulated product will need to be developed so that the content of the product can be controlled during manufacture.

As batches of the product become available from the pilot plant, it becomes possible to extend the scope of the field trials. Selected growers may be invited to try out the product on a part of their acreage and the results will be observed by the manufacturer's technical staff. The extension of trials in this way often helps to show up any shortcomings that might arise later under practical conditions of use and these can be corrected before the product goes on general sale. The national research stations and advisory services may also try out the product. Field studies on the effect of the product on wild life need to be carried out if it is considered there are likely to be risks from its use.

Apart from the development of the product itself, work must be done on the packaging materials, labelling, advertising and marketing so that by the time the development is complete the branded product can proceed smoothly to the market. Not that progress will stop at this point. It is usual to follow-up the practical use of the product after it has been on sale and new uses will usually be investigated to extend its range.

The role of Government

So far the development of a product has been followed through from the point of view of the manufacturer. Government, however, also takes an active part in the progress of new pesticide products to the market. In most of the developed countries, some form of government control is exercised over the sale and use of pesticides. In Britain, there are voluntary arrangements agreed between the Government and the pesticides industry whereby products are considered for their safe use, and can also be considered for their efficacy before they are put on the market. The most important consideration is safety—safety to the user, to the consumer of treated produce, to other people who may come into contact with the material, and also to wild life. This aspect is taken care of by the Pesticides Safety Precautions Scheme whereby all new products or new uses for existing products

are notified to the Ministry of Agriculture for official 'clearance' before they are used in large scale trials by growers or put on sale. Clearances may be for trials only, for limited commercial use, provisional, for sale for a stated period, or without any restriction. Committees of experts in toxicology, medicine, residues analysis, agriculture and allied sciences consider the work done by the manufacturer to establish the safety of his product. If they are agreed it can be used safely, they make recommendations about the conditions of use and the precautions that need to be given on the labels. Warnings will need to be shown about handling by the user, dangers to wild-life, fish and bees where necessary and the time interval that should elapse between the treatment of edible crops and harvest so as to avoid harmful residues. Other precautionary statements will be included if thought desirable. Some pesticides are toxic enough to require that special precautions be taken when using them and these are scheduled under the Agriculture (Poisonous Substances) Regulations. In the case of these products not only are precautionary warnings required on the labels but there may be restrictions on sale and conditions of use. The legislation requires, for example, that workers be provided with and use suitable protective clothing, that washing facilities are available and that hours of work are recorded and kept to certain limits. It is perhaps insufficiently appreciated that pesticide products are not indiscriminately introduced to the market but must pass strict scrutiny beforehand.

In addition to the safety requirements, there is provision under a further Government scheme—the Agricultural Chemicals Approval Scheme—for products to be submitted for independent assessment of their effectiveness. To qualify for the 'A' mark under this Scheme, manufacturers make available for consideration details of the formulation of their products and all the experimental evidence in support of their label claims which is then independently assessed. Officers of the Scheme also visit experimental sites during development to see for themselves how the trials have been carried out and how products are performing.

While for all practical purposes all pesticide products for agricultural or horticultural use pass through the hoop of the Pesticides Safety Precautions Scheme, manufacturers use their discretion as to what they offer to the Agricultural Chemicals Approval Scheme. Much depends on the volume of sales they expect for each product. Nevertheless, upwards of 90 per cent of the products on sale to farmers and growers are now approved under this Scheme. Products cannot qualify for approval until they have first been 'cleared' for safety. The 'A' mark, therefore, has a double significance—the product is at once safe to use as directed and effective for the purposes claimed on the label.

Read the label

By the time a new discovery comes on to the market, it is likely that five or more years will have passed in research and development. A great deal of money and effort will have been spent on working out the conditions of use which are later translated into the instructions for use on the labels of pesticide products. Both industry and Government will have taken steps to see that products are safe to use and will have devised precautions to be taken to safeguard all concerned. These precautions are also shown on the labels. A product is not likely to be either safe or effective unless the

instructions and precautions are carefully followed. The user of pesticides, therefore, as the final link in the chain, has a contribution to make to the pesticide story. It is a small contribution but a vital one and can be simply stated in just three words—**Read the Label.**

This article has been contributed by **E. A. Riley, B.Sc., Ph.D., D.I.C., M.I. (Biol.),** who is a Principal Scientific Officer in charge of the Agricultural Chemicals Approval Organisation. He is concerned with the approval of proprietary pesticide products from the point of view of their efficiency.

Film on Farm Waste Disposal

The following is an extract from a new Ministry film dealing with the storage and disposal problem of farm waste:

> 'The dairy cow is a regular mucker—she will produce about 20 gallons of slurry a day'.

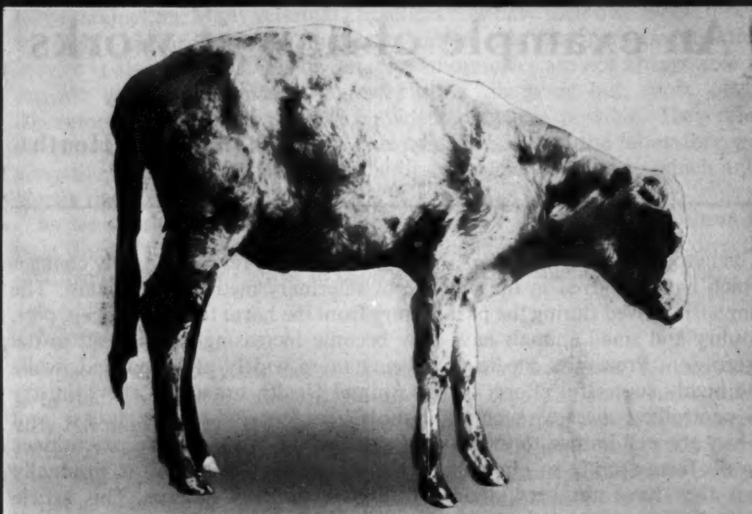
The Ministry's National Agricultural Advisory Service has sponsored a new film, produced through the Central Office of Information, which deals with the modern methods employed on farms for the storage and disposal of slurry and also with its use as a fertilizer.

The factual aspects of the slurry problem are offset by extremely amusing cartoons.

'The Muck Problem' is a 16 mm. colour film and runs for 20 minutes. It is available to the public through the Central Film Library, Government Buildings, Bromyard Avenue, Acton, London, W.3.

An[illegible]th[illegible]

Disease Prevention



[illegible] severely affected with stomach worms

Th[illegible] a topical subject

Contains [illegible]

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Preventive Medicine on the Farm

An example of how it works

G. B. S. Heath

A PREVIOUS article (*Agriculture*, May, 1967, p. 215), reviewed briefly changes which have occurred in the practice of veterinary medicine in Britain. The emphasis moved during the past century from the horse to cattle. Sheep, pigs, poultry and small animals have now become increasingly important to the profession. Preventive medicine is being more widely practised and, while the highly successful efforts of the Animal Health branch of the Ministry in controlling diseases such as swine fever, foot-and-mouth disease and rabies are well known to most people, the efforts of the private practitioner on the farm are not so obvious. New methods have developed so gradually that they have not been noticed to the extent they deserve. This article illustrates the new methods by describing preventive medicine in the calf house.

Curative medicine in calves

Let us consider the veterinary surgeon's approach to calf illness before the last war. The laboratory help available for diagnosis was limited and the amount of research which had been done on calf diseases was not nearly sufficient. Nevertheless the pre-war veterinary surgeons were extremely skilful in their treatments and were able to give sound advice about good husbandry.

The commonest symptom in calves which are ill is diarrhoea. This was treated by taking steps to keep the calf warm and comfortable, ensuring suitable diet and by giving doses of substances such as kaolin, often combined with opium, to control the diarrhoea. Sulphonamides and, after the war, antibiotics, became available and these greatly increased the number of cures which followed treatment. Many of the calves recovered but the farmer could always anticipate that quite a few would become seriously ill each year and at least about five per cent would die.

Preventive medicine—the new weapon

The veterinary surgeon at present is in a much better position to help the farmer whose calves are ailing. He is able to attempt to answer three questions: what is the disease? why has it occurred? and how can future cases be prevented? Correct answers to these questions are essential preludes to the practice of preventive medicine.

Diagnosis

In many cases, clinical signs coupled with the veterinary surgeon's previous experience in the area are sufficient to justify an instant diagnosis. Even in these cases, samples are often taken to ensure correct treatment, especially now that so many strains of bacteria have become resistant to antibiotics. Where diagnosis is not straightforward, samples are often taken for laboratory examination. Many veterinary practices now have their own laboratories; for others, or for more elaborate examination, the Veterinary Investigation Service is always available. Regrettably, laboratories are not always able to provide enough information to establish a diagnosis but, more often, laboratory examinations make a confident diagnosis possible. They often do more than that: if the disease is caused by bacteria, the laboratory will generally be able to say which antibiotics are effective—and to which antibiotics the bacteria are resistant.

So we see that veterinary surgeons are now in a much better position to treat disease successfully, because they are better able to diagnose correctly and, from laboratory results, to choose the best treatment.

Etiology

After deciding why the calf is ill and beginning treatment, the next step is to find what factors allowed the disease to occur. In some cases this is easy but most farmers are now well aware of the correct methods of rearing calves and obvious faults are not common. A lively mind and much knowledge and experience is generally necessary if the correct answer is to emerge.

Let us assume that the results of laboratory examinations have eliminated salmonellosis and confirmed that the calves are affected by 'white scour'. This is caused by a bacterium which cannot be eradicated; it is everywhere in normal farm buildings. Some strains appear to be more virulent than others but the mind boggles at the thought of trying to get rid of even a few types. It may be accepted that the bacteria have always been in the calf house and that they cannot be eradicated. Why, then, did the calf become ill? There are two distinct possibilities for the veterinary surgeon to consider: was the management wrong and was the calf itself deficient in immunity? Normally, he will be able to answer both questions correctly.

Was management wrong?

This will be considered under two headings:

1. Are the surroundings satisfactory? If they are damp, too cold, too hot or 'stuffy', the answer is 'No'. A later article deals with buildings and points out the importance of this aspect of disease prevention.
2. Is the feeding correct? The food itself must be satisfactory and the correct amount must be given sufficiently often. An over loaded stomach causes indigestion and this allows excessive multiplication of bacteria which would not have caused disease in a normal digestive tract.

Was there a defect in the calf?

All animals, including man, have a 'normal non-specific immunity' which confers some protection against all diseases. The new-born are, by means which differ according to species, given extra immunity from their mothers to tide them over the difficult period of coming to terms with their new

surroundings. The calf gets this extra immunity from its mother's colostrum. If the calf has had at least a pint of good quality colostrum (*not* the first post-calving milk from its pre-milked mother) within a few hours of birth, it will absorb so much immunity to its blood that the white scour type of disease is very unlikely to occur. By taking blood samples for laboratory examination, the veterinary surgeon will be able to say if the calves have absorbed enough immunity.

Prevention of future cases

When the underlying cause of disease has been discovered, it is generally easy to say what steps should be taken to prevent further cases. In the present illustration, it might be provision of sufficient colostrum early in life, a change in the method of feeding, alteration of buildings or regular vaccination. Sometimes the farmer cannot carry out the suggestions and there are occasions when prevention might cost too much to be worth while.

In the type of disease described in this article, the best results follow complete collaboration between the farmer and his veterinary surgeon. The days are past when a successful farmer simply presented the patient to the veterinary surgeon and was interested only in getting the affected animal cured. Now he wants to know why the disease appeared and how further cases can be prevented—and the veterinary surgeon wants to tell him.

The Veterinary Surgeon and the Farmer

Since 1939, the increased numbers of livestock in the country, high stocking rates, and modern methods of husbandry have given rise to new disease problems. The introduction of the milking machine and parlour, the intensive production of beef, bacon and pork, intensive sheep production, broiler chicken production, deep litter, batteries and artificial fertilizers are a few of the modern methods of intensification and they have all brought with them new disease problems. These problems and the disease control and eradication programmes of the Animal Health Division of the Ministry of Agriculture, Fisheries and Food are responsible for the greater need for veterinary surgeons.

For agriculture to be prosperous, it must function with maximum efficiency and the veterinary surgeon is available to assist in this objective. The role of the veterinary surgeon used to be like that of a fire brigade; he was only called in when there was acute illness or injury. The role today increasingly does and should consist of a system where he is given the opportunity to foresee the likely onset of disease and to prevent its occurrence.

Control of Stomach Worms in Calves

J. F. Michel

PARASITIC roundworms inhabiting the alimentary tract of cattle are the cause of very considerable loss. This is mainly due to their adverse effect on liveweight gain. In Britain only two species of these worms are of importance at present, *Ostertagia ostertagi* which is found in the fourth stomach and, of rather less importance, *Cooperia oncophora* which occurs in the small intestine.

Much of the damage occasioned by these parasites can be avoided, but a consideration of the means by which this can be achieved demands a knowledge of the life-history of the worms and of the epidemiology of the disease that they cause. The adult worms lead a parasitic life in their favoured part of the gut but the eggs, which the females lay and which pass out of the animal's body with the dung, must undergo some development in the outside world before they change into infective larvae. These migrate on to the herbage where they can persist for many months. It is only when they are swallowed by a calf that they are able to continue their development and grow into adult worms. Thus the worm burden of a calf can only increase if it swallows more larvae while grazing and the infestation on the pasture can only increase if eggs reach it in the dung of infected cattle.

Experimental calves moved in mid-July to pasture not grazed by infected cattle since the winter and given one adequate anthelmintic treatment on the day they were moved

Rate of larval intake

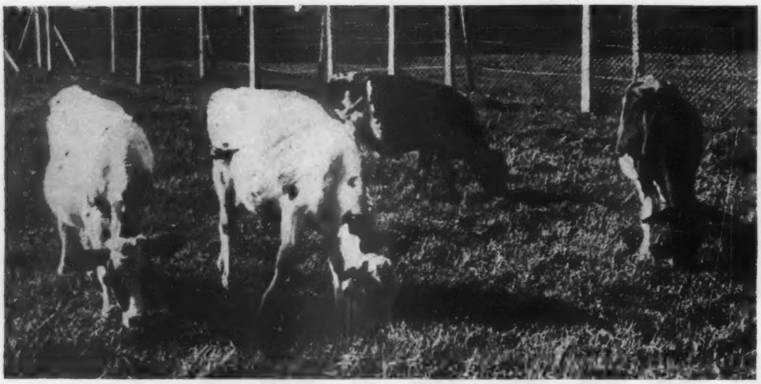
The adult worms are highly prolific and the increase in parasite numbers would be prodigious were it not for a number of factors which tend to restrict it. Calves do not develop a protective immunity to these worms until they have been exposed to infection for some months. Before such an immunity appears however, worm burdens are regulated by other mechanisms of resistance. The effect of the most important of these is that the number of adult worms carried depends on the rate at which worm larvae are acquired, not on their total number. While the intake of larvae remains at a low rate, no matter for how long, worm burdens will be low; if the rate of intake rises, worm burdens will increase. How much damage the worms do also depends on the rate at which larvae are picked up. A low rate of infection produces no effect on the growth of the calf; it is only if a critical rate of larval intake is exceeded that damage results.

The rate of intake of larvae by a grazing animal depends almost entirely on the concentration of larvae on the herbage and the aim of management should be to withhold calves from grazing herbage that is too heavily infected. This situation may arise in two ways. Either one group of animals may be put on a pasture that has been infected by some other group, or calves, exposed to lightly infected grazing and acquiring small worm burdens, then build up the infestation on the pasture to a dangerous level and thus reinfect themselves. Most damaging infections of stomach worms in calves are caused in the second manner.

Previous views erroneous?

In optimum conditions, free-living development from egg to infective larva takes no more than a week and the larvae can migrate on to the herbage within hours. Development in the calf to the mature adult is completed in 16 days so that the shortest time in which the life cycle can be completed is little over three weeks. On the basis of this knowledge it used to be assumed that the process of building up the infection involved several generations of the worms. The lightly infected calves contaminated the pasture; in consequence they became more heavily infected, therefore contaminating the pasture still more heavily and so on. The control measures based on this view were aimed at slowing down the process of increase and took the form of periodic anthelmintic treatment, light stocking, mixed or alternate grazing with other kinds of stock and rotational grazing.

There are a number of reasons for believing that this view of how worm burdens increase was erroneous and the measures based on it inappropriate. Firstly, as has been mentioned, populations of worms in the calf do not increase by a process of simple addition. Secondly, their total egg output is regulated with the effect that contamination of the pasture is the same and follows the same stereotyped course whether the worm burden of the calves is large or small, increasing or decreasing. Thirdly, free-living development and migration of the larvae on to the herbage can take very much longer than the minimum period. The time that must elapse before eggs passed on to the pasture in the early spring appear on the herbage as infective larvae exceeds two or even three months. This period decreases as the season wears on so that eggs reaching the pasture at midsummer will become infective and available to the grazing animal in two or three weeks. Consequently, the eggs passed during the whole spring and early summer are likely



Calves maintained under exactly similar conditions as in the photograph on p. 278 except that they remained on the same pasture throughout the season

to appear on the herbage as infective larvae during a short period, and indeed the level of infestation on a pasture contaminated in this way rises sharply in July to a high level. Thereafter there is normally little further increase. Conditions for the survival of developing larvae do not appear to be as favourable as they were in May and June and worm eggs reaching the pasture in the second half of the grazing season make only a small contribution to the infestation on the herbage. Levels of herbage infestation on pastures not contaminated after July are little different during the autumn and winter from those on pastures that are contaminated for the rest of the season. Eggs dropped after September are apparently not able to complete their free-living development. The infective larvae which are already present, however, persist through the winter and it is not until the early spring that the concentration of larvae on the herbage decreases, usually during March and April.

Cause of damaging infections

To recapitulate, the infestation on the herbage of pastures grazed by calves may be expected to be at a harmlessly low level in the spring when the calves are turned out, to rise rapidly to a high level in July and to remain at that level until the early spring of the following year.

Calves become lightly infected when first turned out in late April and begin to contaminate the pasture in the second half of May. Their output of worm eggs rises to a peak in June and then decreases gradually for the rest of the year. The eggs passed in May and June appear on the herbage as infective larvae in July. It is these larvae which are the cause of damaging infections which prevent the maintenance of a satisfactory rate of liveweight increase or give rise to more severe symptoms of disease. Thus, where the genesis of disease is concerned, only one generation of the parasites is involved and control measures must be aimed, not at reducing the rate of increase of the infestation, but simply at withholding the calves entirely from the new generation of larvae.

This could be attempted by moving the calves in the middle of July to pastures which had not been grazed since the winter and which would by this time be almost free of infection. Since the calves are a source of infection they would contaminate these clean pastures. The resulting increase in the

herbage infestation which might be expected to begin in August would not normally be rapid. Nevertheless, treatment of the calves with an adequate dose of an effective anthelmintic at the time that they are moved in mid-July is recommended. This might prevent and would certainly postpone contamination of the clean pastures. Such postponement would be beneficial partly because conditions for the creation of herbage infestations become less favourable as the season advances and partly because the resistance of the calves to the effects of infection increases.

Control measures

These control measures, which should fit readily into most farming systems, depend on the predictability and regularity of the course of infestations on the pasture. Observations carried out in the south-east of England over the past seven years suggest that divergences from the expected pattern are not likely to be wide. Controlled trials of the suggested measures which have been in progress since 1964 have given encouraging results, groups of calves which were dosed and moved, gaining between 60 and 150 pounds per head more than other groups grazing closely similar pasture though remaining on the same ground throughout the season. These trials are continuing and observations have begun to study the seasonal pattern of infestations in other parts of the country.

Although this work is not complete, there are grounds for hoping that stomach worm infection in calves, which is estimated to cause an annual loss of about two million pounds sterling, may prove to be readily controllable.

Growing Maize Grain

P. R. Peachey

MAIZE grain has been harvested commercially for four harvests, 1963–66 inclusive, by Messrs. Boswell at Mersley Farm, Newchurch, Isle of Wight. Whilst the scale of operations has been small—3½ acres in 1966—it has served to show the problems and prospects of growing this crop as a financial proposition in parts of the south of England.

The average yield over the four years has been 49 cwt per acre at 16 per cent moisture content. The gross margin per acre works out as follows:

Variable Costs		*Output*	
	£		£
Seed 23 lb	3·2	49 cwt at 24*s*.	58·8
Fertilizer 7 cwt (22 : 11 : 11)	8·75		
Spray 2 lb simazine	3·3		
Grain drying	6·0		
Extra harvesting cost	2·0		
Bird scaring	·25		
			−23·5
Total variable costs	23·5	Gross margin per acre	35·3

In fact, the 1966 crop was sold locally at £26 per ton, whereas the average port price of imported maize of all grades in 1966 was about £24 per ton. The gross margin of 35 cwt per acre barley is £26 per acre on the same class of land and to equal this one would have to grow only 41·6 cwt maize. This takes into account that there is no cereals deficiency payment on grain maize. The charge of 5*s*. per acre for bird scaring is based on one man patrolling for three weeks for two hours at dawn each day, and able to cover 100 acres. In fact no such charge has been incurred as yet, for volunteers who enjoy the permission to shoot rooks, pigeons and other vermin have been prepared to do the job free of charge. No value has been given to the stover left behind by the combine harvester as this has always been ploughed in, but analysis shows its feeding value to be at least equal to that of barley straw.

Close-up of maize in trailer

Harvesting

In the last two years, harvesting the grain direct by Claas combine harvester has yielded grain at about 35 per cent moisture content. The grain was dried by a Bentall continuous flow drier, at 100°F for 2 hours initially, and then it was left overnight. This was followed by two 4-hour periods at 140°F with an interval of 24 hours between them. This treatment allowed equalization of moisture within the grain, prevented cracking and resulted in an end product of 16 per cent moisture content. Grain lost in the field was recorded as 180 lb per acre calculated to 15 per cent moisture content. In the first two years a cob picker was used, and crib storage and drying gave a sample which was worth £2 per ton more than the direct combined grain. The former sample was shown at Mark Lane and was considered to be superior to imported grain by competent grain importers. The cribs of wire netting were 4 ft wide, 6 ft high and as long as necessary. They were roofed over but unprotected on the sides.

Husbandry

The variety grown was Kelvedon 59. It was drilled with a Stanhay precision seeder on 28 in. rows at 23 lb per acre, which allowed about 35,000 seeds, 6–7 in. apart in the rows. The breeder of this variety calculates this to be the optimum plant population, but Isle of Wight experience indicates that an allowance should be made for a 20 per cent loss of plant due to various causes. The seed was dressed with captan to avoid fungus attack and 7 cwt per acre of a (22 : 11 : 11) fertilizer was worked into the sandy loam soil. The seed was put in at 2¼ in. depth in the first week of May, on a seedbed that could be likened to a deep barley tilth, care being taken to see that no loose seeds were left on the surface to attract birds.

The pre-emergent weed controlling simazine was sprayed on at 2 lb per acre in 60 gallons of water immediately after sowing. This was very effective against annual weeds though small pieces of perennial grass weeds survived. No mechanical weeding was necessary at all. Slight ground frosts did not appear to harm the young crop.

Pests and diseases

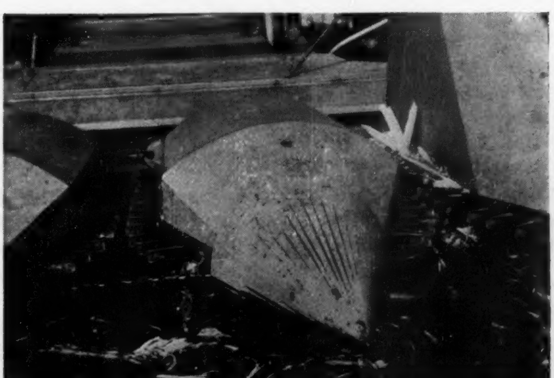
Frit fly has been experienced on one occasion and was dealt with by the application of phorate granules at 15 lb per acre. Mention of rooks has

Combine harvesting the crops

already been made in a previous paragraph. Wireworm has not been experienced but preventive measures are available if necessary. Fungus disease such as the foot rots are not a problem.

Discussion

The crop has not clashed with other cereals in either sowing or harvesting and the drier also was free at this time. The average date of harvesting has been November 12th. Although this may seem late it is no later than when red clover seed is sometimes taken; moreover in 1965, when storms on the previous night had made the ground very wet and the crop somewhat lodged, it presented no difficulty to the combine harvester that had a special adaptation for heading. It takes three rows at 32 in. with torpedo dividers and fingers on chains to draw in the plants. One acre per hour can be dealt with comfortably. The adaptations necessary to the combine would cost in the region of £650.



Close-up of combine header

The harvesting of the crop can be spread over three weeks, possibly more, and thus such a relatively expensive piece of machinery could be shared co-operatively by a number of growers. The precision seeder is a tool which can be used over a considerable variety of crops, ranging from kale and numerous brassica crops to sugar beet, peas and beans. It would be possible to sow fourteen acres per day allowing one machine to cover approximately 100 acres at the optimum sowing period.

The future

As a break crop it is not ideal, as it does not give a complete kill of perennial grass weeds, but a great deal can be done in this respect by cultivations before sowing if the spring is favourable. The harvest period is too late for it to be followed by a winter cereal. So far no deleterious effects from simazine have been seen on any crops sown the following spring. It cannot be said to enhance soil fertility with nitrogenous residues as it does with beans or other leguminous crops, but root and stover residues contribute to the maintenance of soil structure. However, since it can be taken safely for two or more years in succession, it does help to arrest the continuance of cereal diseases which are a serious risk in long runs of corn crops.

There appears to be a good market for well presented samples of this high energy grain at a premium of £5 per ton over barley. Additionally, it could to a small extent, replace some of the ever-growing barley acreage and avoid the need to import some of the 3¼ million tons of maize from overseas.

With the husbandry of the crop becoming reasonably well known and the progress in harvesting and drying being made, it is confidently expected that plant breeders will go on working towards varieties that are hardier, earlier ripening and therefore even more suitable for our climate. The potential acreage on the Isle of Wight is a matter for conjecture, but certainly there are 2,000 acres of suitable land well situated for the crop, possibly considerably more than this on sheltered suitable soils in the south of England. Perhaps the principal barrier to the advance of maize for grain in this country is the conservatism which so often surrounds any new practice.

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Break Crops

The current series in *Agriculture* on intensive cereal growing will include articles on break crops, such as spring and winter beans, oil seed rape and a further one on maize growing.

Finance in Agriculture

Adrian Collingwood

THE agricultural scene changes continually and so too does the financial climate within which the industry must operate. Sometimes the variation in financial conditions is due to external influences such as the recent damping down of the economy but often it is a direct consequence of the agricultural situation itself. As an exaggerated but, nevertheless, pertinent example, when in the late 1920s and early 1930s the conditions were such that the farmers themselves lost confidence in the future of their industry, it followed that creditors would be equally unhappy and would take precautions to guard against losses. Similarly, only the visionaries felt it wise to invest additional capital in farming at that time and, incidentally, how well their courage paid off.

Falling profits

We have come a long way since the 1920s and conditions now are in no way comparable with those that pertained then, but towards the end of last year it became apparent that doubts as to the future were again developing amongst farmers. These were attributable to reducing profit margins, new legislation that was not fully assimilated, falling yields possibly due to adverse weather conditions assisted by doubtful but temporarily accepted farming practices, and the possibility of this country's entry into the E.E.C., the full implications of which were difficult to determine. Problems tend to be exaggerated, particularly in farming, but I can vouch for the falling profits and I know that some farmers were finding it difficult to keep to their arrangements with the banks.

The resulting financial picture in British agriculture was that, by and large, the build-up of capital from retained profits—never very dramatic—had slowed down; prices of farms were falling in some areas and the demand for

credit—with exceptions that I shall mention—had eased. Needless to say, there were still some successful farmers who felt that the fortunes of the industry were cyclical and who were prepared to invest in the future, but there were others who preferred to consolidate for the time being and machinery manufacturers in particular felt the consequence of this attitude. On the other hand some of the less creditworthy farmers found themselves compelled to seek more credit to intensify their enterprises in an endeavour to increase profitability to a more reasonable level.

Farmers are notably resilient, however, and one always felt that with only a little encouragement in one form or another confidence could be restored. Fortunately, that encouragement is contained in the Annual Price Review 1967; having regard to the general background of restrictions on prices and incomes I consider it to be an eminently fair one. Perhaps even more important than the attempt to rectify the profit situation is the clear indication of the Government's desire that domestic food production should increase, on a total acreage that must diminish inevitably as more land is taken for roads, building development and afforestation. Surely some of the doubts about the future have now been dispelled?

New capital

Various estimates have been made of the additional finance that will be required if British agriculture is to reach its full potential and some of the figures mentioned are quite staggering. Again the question has been raised as to the possibility of attracting outside capital to the industry. It is my personal opinion that until the profitability in conventional farming is in still closer relation to the capital investment, only the factory type of enterprise can hope to achieve the results that might encourage outside investors to subscribe capital. In his recent 'Ernest Sykes Memorial Lecture' to bankers, Mr. Tristram Beresford forecast that ultimately much more food would be produced by factory methods, but 'ultimately' can be a long time and many problems will need to be solved before his prediction bears fruit. In the short term, therefore, it is difficult to foresee any major injection of new capital into the industry from outside sources.

Excluding the possibility of investment by the public, finance for the further development of agriculture must be found from the farmers' existing capital resources plus profits retained in the future, from government grants, and from credit. Let us now consider in some detail, therefore, the sources, the current availability and the cost of credit together with the thorny question as to what constitutes 'creditworthiness'.

Sources of credit

Virtually all rates of interest are either linked directly to, or are influenced by, the Bank Rate which, following three recent reductions, presently stands at 5½ per cent. By past standards the cost of credit is still high and this has a deterrent effect on borrowers particularly where long-term commitments are involved. Here one might make the comment that many farmers who preferred to use bank credit for the purchase of farms and subsequently found themselves paying interest of 8 per cent per annum must have wished that they had arranged long-term mortgages at fixed rates in 1963/4 when, by comparison, the rate structure was low. It is difficult to imagine anything more

thwarting to forward budgeting than a sudden increase of 2 per cent or more in the cost of credit.

The sources of credit for farmers seldom alter, and remain as follows:

Long term (For the purchase and improvement of farms)	The Agricultural Mortgage Corporation, the Lands Improvement Company, private mortgagees, some insurance companies, and—to a limited extent—the banks.
Medium-term (To finance machinery, equipment and some types of buildings)	Hire purchase companies and the banks.
Short-term or Seasonal (For livestock, feed, fertilizers, etc.)	Merchants, agricultural trading societies and the banks.

Long-term credit continues to be in comparatively short supply and the recent announcement that the Agricultural Mortgage Corporation had reduced the interest rate on mortgages from $8\frac{1}{2}$ per cent to $7\frac{1}{2}$ per cent, that farmers would be offered a wider choice in methods of repayment and that more discretion would be allowed in valuing farms was particularly timely, for the Corporation is the main source of long-term credit for the purchase of farms and will now be able to operate with greater elasticity.

Some farmers feel that the current price of farm land is out of relation to its earning capacity but whether or not this is true it is always sound business practice to ensure that land already owned is maintained in the best possible condition, and in this connection where the banks hold the deeds of the relative farms as cover for existing facilities they may still be persuaded to provide finance for sensible improvements that will increase productivity and, consequently, profitability.

Creditworthiness

There is a fair but not unlimited supply of medium-term credit and there is no shortage at all of short-term or seasonal credit, but because of the difficult trading conditions more searching tests of creditworthiness have become necessary. Assuming that the borrower has integrity—without which one would not want to do business with him at all—his creditworthiness depends upon the view the lender takes about his ability to service and ultimately repay the credit granted. The three most important factors that influence the lender's decision are (*a*) the income of an individual or the profitability of a business, (*b*) the extent to which the borrower can conserve part of that income or those profits and (*c*) the relation between the borrower's own capital and the credit taken and sought.

The only true guide to farming competence is the profit record of the relative enterprises over a period. An occasional adverse manifestation of nature in the form of disease or weather is an accepted hazard in food production, but if the set-backs occur with a frequency that goes beyond the bounds of coincidence the management comes into question. When profits over the years fall short of the amount required to service and repay the credit—and accepting the fact that the same credit will need to be taken again to finance a new cycle of production—then it is not unnatural that creditors should become uneasy about the situation and take appropriate precautions. Similarly, creditors are aware that the proprietor's stake in the business constitutes their buffer against loss; if, for one reason or another, this stake is denuded, or if it is obvious that credit is being used beyond the

extent to which the proprietor's capital can provide an adequate safety margin then again the creditors are impelled to take action. It is imperative, therefore, that those farmers who use credit should not only keep accurate records but should be able to explain them to an outsider. Statistics can never be a substitute for good farming but without them success cannot be measured nor weaknesses exposed. Profit and loss accounts and balance sheets are not documents composed to keep the Inland Revenue quiet—they record the history of the business and are of extreme importance to creditors who may be called upon to continue or to increase their financial assistance. It is good, therefore, that grants should be available for record-keeping and there is little doubt that the administrative side of farming will benefit accordingly.

Summary

To summarize the position and conclude this short article, farmers who can prove their success and point to the sound financial position of their businesses need not go short of credit and if they wish to expand their activities within reason they will be able to do so. At the other end of the scale those whose past profit records have been unsatisfactory face further difficulties, and in between are the border-line cases, each of which will be judged on its merits.

This article has been contributed by **Adrian Collingwood, F.I.B., T.D.,** who is General Manager (Agriculture) of Midland Bank Ltd. Born in Driffield, East Yorkshire, he has made a special study of finance for agriculture and it is on this subject that he is well known as a writer and broadcaster.

Farm Rents in 1966

It is regretted that Table 1 included in the article *Farm Rents 1966* published on page 195 of the April, 1967 issue of *Agriculture* contained some errors.

The following Table Table 1 should, therefore, be substituted.

Table 1

Average rent per acre* of crops, grass and rough grazing at mid-October, 1966

Ministry of Agriculture region	Predominantly upland estates £ s d.	Predominantly lowland estates £ s. d.	Mixed upland and lowland estates £ s. d.	All* Estates £ s. d.
Eastern		4 14 6		4 16 6
South-Eastern	3 15 6	4 13 6	4 5 0	4 12 0
East Midland	1 18 0	4 11 6	4 0 6	4 9 0
West Midland	2 8 6	5 5 0	4 6 0	5 3 0
South-Western	2 14 6	4 7 0	3 15 6	4 4 0
Northern	16 0	3 12 6	2 6 6	2 6 0
Yorkshire and Lancashire	14 6	4 6 0	2 5 6	3 3 0
Wales	19 6	3 1 6	2 4 0	2 6 0
England and Wales	1 2 6	4 9 6	2 17 6	3 16 0

*The figures for 'All estates' are averages of the counties in each region weighted by the total rented acreage in each county Those for the separate categories of estate are derived from acreages and rents in each county in the sample only. Changes in the sample of estates included in the enquiry cause fluctuations in the rents shown by successive enquiries for particular regions and categories of estate.

Moist Grain Storage

P. N. Harvey

Director, Gleadthorpe Experimental Husbandry Farm

THE traditional corn harvest was a long drawn-out campaign in which the speed of advance was dictated by the weather. Today harvest is a rapid assault and if the combine can work for a few days without interruption by rain a large quantity of damp grain soon accumulates. This mass requires immediate attention or it will heat up and spoil. In recent years the problem has worsened because combine harvesters have become bigger, and because for rotational reasons the output of barley on many farms now exceeds the capacity of existing drier and storage plants.

Airtight storage of moist grain is one way in which the pressure on drying facilities at peak periods can be relieved. Harvest can then proceed with the minimum of delays taking full advantage of good combining weather.

How it works

The principle of the method is briefly described as follows. Damp corn in contact with air heats up and goes mouldy because fungi and insects thrive on this combination of food and moisture. If, however, the grain is stored in a sealed container to prevent free circulation of air, the oxygen in the air surrounding the grain is quickly used up by these living organisms and is not replaced. Without oxygen the growth of the insects and fungi ceases before any harm is done to the grain. Even when the grain is very damp (25–30 per cent moisture) airtight storage prevents mould activity, but grain as wet as this ferments slightly in an oxygen-free atmosphere and this affects its value as human food although it remains quite suitable for livestock. The fermentation, however, kills the seed germ; therefore, airtight storage is ruled out for seed corn or malting barley.

Airtight storage

There are two main conditions for success in applying this principle to farm storage. Firstly, the construction of the container must provide an effective seal to prevent the entry of air during the storage period. Secondly, there must be some means of taking grain out of store as it is needed without letting in so much air that the condition of the remaining corn deteriorates. Practical experience suggests that the grain will keep quite well in a closed silo or bag which is not perfectly sealed. The more urgent problem is to prevent air entering the silo during withdrawal. In the more expensive metal silos, air exchange is kept to a minimum by a system of built-in unloading augers and devices to control changes in air pressure as the volume of grain in the silo lessens. With other types of silo, including flexible containers, grain is withdrawn by inserting an auger through a hatch into a duct or system of ducts leading from the exterior to the centre of the grain mass. Whatever the means employed, it is important to reseal any entry port as soon as the grain has been unloaded. Provided that this is done, the oxygen in the small amount of air admitted each time a withdrawal is made, seems to be used up so that soon afterwards the atmosphere within the store reverts to its previous state. In the case of a silo provided with built-in unloading augers, grain has been withdrawn once or twice a week from October to April without any appreciable deterioration in the condition of the grain.

Two types of butyl rubber containers for moist grain

Problems in practice

A question often asked is whether grain has to be loaded continuously into the store until it is full or whether the store can be half filled and left for some days before loading is resumed. This is an important practical point because there is often a conventional storage system on the farm as well as a moist grain store, and it is often convenient to change from one crop to another according to the progress of the harvest, or to dry only the grain which needs least drying, leaving the wetter corn to be loaded into a sealed store. Experience at Gleadthorpe has shown that grain at 18–22 per cent moisture can be loaded at intervals of around fourteen days without

troubles developing, provided that the hatches are sealed after each spell of filling. The margin of safety with very damp grain (about 25 per cent moisture content) is probably less, but on one occasion the final load of barley at this moisture content was put into a 60-ton store ten days after the first grain was loaded without untoward effects. With very damp grain, filling should proceed continuously if at all possible.

Bridging within the store has sometimes proved an intractable problem. The risk of caking or bridging is greatest when the grain is very damp. This is a sound argument in favour of storing at 'medium' moisture content (18–22 per cent) wherever possible. However, in late, wet districts combining damp corn is a normal hazard of harvest. For these conditions there is much to be said for having some method such as a sweep auger for agitating the grain within the silo as an insurance against bridging troubles. With grain at 18–22 per cent moisture content, the risk of bridging is much less and cheaper more simple systems of unloading are quite effective. Very damp grain has the additional disadvantage that it only keeps in good condition for a short time after withdrawal. The shelf life may be up to a week in winter but only three days in warm weather. Medium moisture grain, however, can be safely stored in holding bins for two or three weeks after withdrawal and this flexibility in handling can be useful in many situations, although in a fully mechanized feeding system, where grain is taken out every day, the argument against high moisture grain has not the same force.

Moisture content and loading

One advantage of moist grain storage is that cereal crops can be cut earlier than normal before the grain is uniformly ripe, and before field losses due to shedding, or wind damage have become serious. Green corns are not a problem because although they turn brown in the sealed store and no doubt have little feeding value they do not spoil the sample during storage. The same applies to weed seeds and normally no preliminary dressing is needed before loading. This is a decided point in favour of sealed storage although if the cereal crop is very weedy some layering may result when grain containing a lot of weed seeds is blown into the store. Blowing is the normal method of loading tall towers but for stores up to 15 ft high loading by auger is quite practicable: movement of grain in two stages using a pair of augers is effective with towers up to about 20 ft in height. Whatever method is used it is vital to avoid delay as troubles can develop in store if grain has started to heat up before it is loaded into the tower.

It is often asked whether it is advisable to load batches of grain of varying moisture content into the same silo. At Gleadthorpe, grain of very widely differing moisture content, i.e., 17–30 per cent, was stored in a 10-ton plastic bag without any ill effects. In this instance the zone derived from a very wet load could be distinguished when the time came to take the grain out, and there did not appear to have been much movement of moisture into the adjoining drier layers. To avoid blockages at the base of the silo where the withdrawal ports are sited it has been suggested that filling should begin with a load of dry grain and there is some practical evidence to support this idea. Dry grain stores perfectly well in a sealed silo and, except to improve the physical condition of the grain, there is no reason to moisten it for safe keeping. If the weather allows the grain to be combined at 18–22

per cent, all well and good, but experimental work does not support the idea that very wet grain has improved digestibility and feeding value and that this justifies the addition of water to bring the moisture content up to around 25 per cent.

An ideal food for livestock

So far we have considered moist grain as a means of easing the congestion caused by the flow of undried grain from the combine at peak harvest periods. But there is another side to the story. Grain cannot be safely stored in bulk for more than a short time at a moisture of more than 14–15 per cent. Unfortunately, when grain that is dried down to this point is milled or rolled, the resulting feed is either dusty or contains an undue proportion of unbroken grains. At 17 or 18 per cent moisture, however, cereal grain can be crushed to form flat flakes in such a way that the fibre of the berry is preserved intact. In this physical condition the grain is not only more palatable but can be fed intensively on a minimum roughage system without the risk of digestive upsets or waste of food resulting from the passage of undigested whole grains through the animal. Nevertheless, the results of feeding experiments at Gleadthorpe and elsewhere do not show that the slight degree of fermentation in airtight storage has any magic effect on the digestibility or feeding value of the grain. Pound for pound of dry matter there appears to be little difference in utilization between dry and moist grain. When cattle are fed to appetite they eat more moist barley than they would if offered dry grain because rolled moist barley is more palatable. Liveweight gains are correspondingly higher and there is some evidence that at high rates of intake, the feed is utilized more efficiently. But if barley is rationed to supply equal amounts of dry matter irrespective of the moisture content of the grain, then liveweight gains are very much the same. We find, however, that the cattle fed on moist barley seem to catch the eye and have a little more bloom on them than those receiving dry barley. It is also evident that in an experiment designed to compare livestock performance on equal intakes of dry matter, the smaller appetite of the cattle on dry barley limits the amount that can be offered to the beasts on moist grain. The latter are thus penalized to the extent that their feeding is in effect restricted whereas those on dry barley are fed to appetite.

Rolling or crushing is normally preferable for cattle feeding but pigs are reported to do very well on coarse ground medium moisture barley and we have included ground 18–20 per cent barley in poultry rations with satisfactory results. Processing by hammer mill grain with more than about 22 per cent moisture is very slow but modern fluted roller or crimper mills can deal with much wetter grain than this with an output high enough for all practical purposes.

Costs

Considered simply as a system of grain handling the cost of airtight storage compares quite favourably with on-floor storage, except, of course, that a sealed silo is a specialized building suitable for one purpose only, whereas a floor store can be adapted for other uses if need be. A typical net cost assuming approval of grant for a vitreous enamel coated store is about £8–9 per ton stored, to which must be added another £2 per ton for a silo equipped with breather bag and sweep-arm unloader. Flexible rubber bags

complete with supporting structure cost around £5 per ton including an unloading auger. These containers holding from 25 to 40 tons have a special attraction for the man who only wishes to store a limited quantity of moist grain, because the unit cost of small metal silos is relatively greater than that of the larger models quoted above. We need to know how long a flexible container of this type can be expected to survive reasonably careful farm treatment before a fair comparison on the basis of annual costs can be made with the more permanent stores. But the development seems very promising although teething troubles during emptying have been reported, especially in the case of bags unprotected from the weather where water has accumulated in the upper part of the bag as grain is withdrawn. One potential advantage of the flexible container is that if a relatively small quantity of grain is needed for summer use, it can be stored separately from the main bulk in the permanent store. The risk of grain going wrong in a sealed store is greatest during the spring and summer when a small amount of grain is left in a large silo. The combination of warm weather and a lot of air within the store can be disastrous and this is the argument for keeping a separate container sealed until the end of the winter.

Summing up

Many large cereal growers who regard barley as something to sell rather than as food for livestock will no doubt continue to handle their grain by conventional methods of drying and storage. By so doing they make sure that their barley can be sold at any time of the year in a condition completely acceptable to the merchant. If a proportion of the output is needed for stockfeed, this can be either chilled or passed through a steamer to raise the moisture content: alternatively, the disadvantages of feeding dry barley can be accepted.

But, for the mixed farmer who because of changes in his farming system is growing more cereals than his drier or grain store was designed to handle, a sealed silo for moist grain provides the extra storage capacity he needs and at the same time relieves the pressure on the drier at peak periods and preserves the grain in an ideal condition for processing as stockfeed. The same arguments hold in the case of an off-farm with livestock buildings but no facilities for storing grain.

For the farmer in the wetter districts of the North and West who wishes to grow barley but has misgivings about the risks of late wet harvests, moist grain storage offers a solution to his problems. In his case the sealed store is not merely complementary to alternative forms of storage but may come to be regarded as the conventional system.

53. Harrogate, Yorkshire

J. Tasker

THIS northern Spa, whose green Strays penetrate into the town centre, lies in the most southerly tip of the district which extends west, east and north to encompass a considerable variety of soil types and consequential farming systems. To this add scenic beauty and a little ancient history. There is no heavy industry to spoil the landscape, but the more genteel, cleaner light industries are increasing, especially on the town's perimeter.

The clearest picture of the main agricultural features can be seen by starting in the west where soil, derived from millstone grit, overlies a most uncompromising clay and the contours rise to 500 ft! Here small grassland dairy farms predominate, with stock rearing and horned sheep for good measure. There are, however, pockets within the zone where nature has sufficiently relented to allow indulgence in arable cropping.

The ancient City of Ripon lies in the northern sector and is surrounded by an area of mixed farming where the geology ranges from drift to gravel beds with isolated pockets of limestone. Dairying is interspersed with cash cropping and beef production, ewe flocks are larger and of lowland breed, many of which are Mashams, a local product.

Ripon is bounded by the river Ure to the north and this river forms the boundary with the North Riding for several miles as it flows eastward. The market place, filled with stalls on market days, is dominated by a large column erected as a memorial to a local mayor and parliamentarian. Every night, promptly at 9 p.m., the hornblower, suitably attired, blows a long blast from an equally long horn at each corner of the monument. This practice has prevailed unbroken for over 100 years. Not far from here the cathedral, parts of which date back to the seventh century, stands at the highest point and is a landmark for miles. Fountains Abbey, one of the largest and best preserved ruins in England, lies in a small valley on the banks of the Skell about three miles to the north-west.

Travelling east towards Boroughbridge the road passes through an improving farming area, with units in excess of 500 acres, where small slices of grassland stand out like emeralds in a setting of rich brown earth. Potatoes and sugar beet are much more in evidence as crops in their own right rather than as breaks in a cereal rotation. Dairy farms are the exception and wintering of sheep on turnips is still practised.

Boroughbridge, a small rural community, has changed very little in the past 40 years. The A1 ran through it until the by-pass was built and at that

time its three hotels, one an old coaching house, were well known to travellers. Three monoliths, known as the Three Arrows, are situated on its western outskirts. They are of solid stone, set in a dead straight line and have been the source of much speculation as to their origin and purpose though without much authenticity. Due east of Boroughbridge the village of Aldborough, with its maypole and 14th century church, was the site of a Roman camp. The museum and grounds hold many relics of the occupation. Within the precincts parts of the original earthworks remain and there are two areas of well-preserved tesselated pavements.

Leaving Boroughbridge in the direction of York the road passes through an area of good farming country. Here soil derived from Bunter sandstone and pebble beds is free working, well drained and early. The farms are in the 300 acre range, with large areas of barley, to which the land is particularly suited. Dairy farms are few and far between and mostly on the small side. Large flocks of ewes produce early lambs mainly for the fat lamb trade but some are wintered on turnips and sold as hoggs the following spring. Beef enterprises rely more on purchased stores than home reared calves. County Council smallholdings are scattered amongst the larger farms and are easily identified by the black and white painting on the houses and the Dutch type buildings common to them. The average size is 50 acres and each has a designated farming system which the tenant must follow. Their value as a starting point for young people is apparent from the high proportion of occupiers who graduate to larger farms. The present trend is to increase their potential by adding the land to one or two neighbouring holdings when one of a group becomes vacant.

Going south from Boroughbridge, towards Knaresborough, another area of mainly arable farms is traversed, with grassland becoming more apparent nearer to the river Nidd which flows through this market town. The soil is neither so kindly nor so fertile; nevertheless, unit size and production are above average for the district as a whole. Up to a few years ago the market square in Knaresborough was cobbled but now only a small area round the market cross remains. Within the square's confines several shops and businesses go back to the seventeenth century one of which, a chemist, claims to be the oldest in England and looks as though it could be. Knaresborough's main feature is the remains of a medieval castle sited on the edge of a deep ravine worn by the river Nidd. Relics of its past are housed in the only usable part and include a dungeon where Eugene Aram, of local notoriety, is said to have lain. On the opposite bank Mother Shipton's cave still remains not far from a dropping well where visitors hang objects which eventually become petrified by the lime water dripping on to them.

Knaresborough is five miles from Harrogate and the land between the two is back on to the aforementioned clay. Considerable areas have been lost to housing development which has fortunately been on the poorer land. A few farms still remain amongst the new estates, but being subject to trespass of various sorts are mainly concerned with milk production for local consumption. And so they will remain until obliterated by inevitable future development.

The Behaviour of Beef Cattle in an Enclosed Building

E. R. Butler and L. M. Parsons
Agricultural Land Service, London

A PREVIOUS article in this series (Vol. 74 No. 2 February, 1967 p. 97) referred briefly to a pilot study carried out by the A.L.S. in 1964 when Activity Sampling was used to investigate the relationship between the behaviour of dairy cows, the change of space standards and systems of housing in use on farms.

Recently the A.L.S. undertook a further study on the behaviour of beef cattle. This was carried out in conjunction with the Farm Buildings Centre, National Agricultural Centre, Kenilworth, as part of a 3–5 year programme of studies and recordings to test the suitability of an industrialized system for a standard building for beef cattle. The building erected for the purpose consists of a frame of 4 × 2 in. hollow sections 96 ft in length and 40 ft wide. The roof is clad with corrugated metal sheeting while the walls and gables consist of 7 × 4 ft timber framed panels clad each side with $\frac{1}{4}$ in. oil-tempered hardboard, held in position by quick-release 'U' channels. Ventilation is by a 12 in. continuous opening under the eaves, a completely open ridge and sheeted gates at each end of the feeding strips.

The pens being 24 × 20 ft are constructed to hold twelve animals allowing 40 sq. ft and 2 ft manger frontage per beast up to 10 cwt. One water bowl per pen is provided.

The bedded area is fenced off from a 7 ft wide feeding strip (one side slatted) adjacent to a double-sided manger 4 ft 6 in. wide. The arrangement of the pen fronts and gates facilitates cleaning out, daily inspection, etc., without having to remove the animals from the building.

During the study there were 94 animals in the building using the four variations of bedded/feeding areas provided and these are shown on the plan on page 301. The following Table indicates the percentage of occupancy of these areas derived from the investigation.

	Traditional	Concrete slats	Metal slats	Cubicles
Area of Activity	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Bed . . .	64·89	64·22	65·20	60·62
Manger . .	26·18	24·07	22·62	18·56
Exercise . .	8·87	11·52	12·00	20·72
Drink . . .	0·06	0·19	0·18	0·10

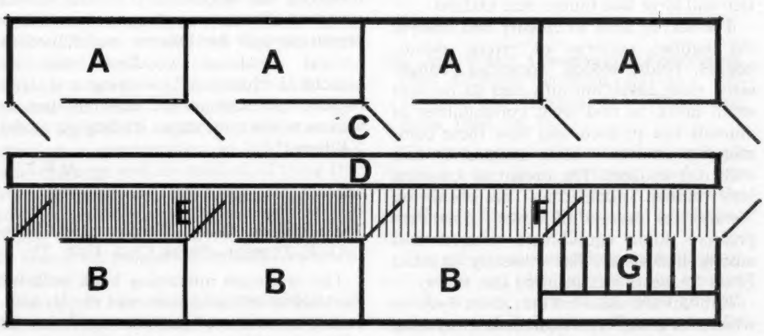
As was to be expected, the peak activity at the manger centred round feeding times. Surprisingly enough, the cattle did not anticipate arrival of fodder by waiting in this particular area. From 7 to 8 a.m. the recordings showed that only a very few (0·5 per cent) cattle were at the manger, but as soon as food was made available at 8 a.m., 86 per cent of all the cattle were feeding between 9 and 10 a.m. By midday, only 20·5 per cent still remained at the manger. The afternoon feeding routine gave a similar though shorter pattern.

One or two beasts were in the exercise/manger area even in the very early hours. But generally it was during these early hours that the cattle were most settled in the bedded areas. The bedded areas had the highest occupancy rate recorded between 4 and 5 a.m. when 95 per cent of the cattle were lying down.

How long do cattle spend drinking? It has been suggested that 'not very long' would be the answer. When it was further suggested that water bowls might be used to replace water troughs, the traditionalists became really concerned. The latest observations tend to support the theory that large troughs may be unnecessary, but that any new bowls should be redesigned because of the low rate of flow of water into present types available. Water bowls of conventional type were, in fact, used in the building in which this study was made.

The number of cattle in each type of accommodation and the time available was, of course, too small for firm conclusions to be reached. Nevertheless, the comparison provides some useful information which, with the further data likely to be obtained from the continuing investigations over the next few years, might be expected to indicate the type of industrialized building best suited to the needs of beef cattle.

Plan of Building



A. *Traditional solid floor with straw bed*
B. *Solid floor with shavings bed*
C. *Solid floor*
D. *Manger*
E. *Concrete slatted floor*
F. *Metal slatted floor*
G. *Cubicles (bed of shavings)*

Farm Building Centre

A building of the type described in the article may be seen at the Beef Housing exhibit which is in the livestock demonstration area at the Farm Building Centre, Kenilworth.

Books

The Pattern of Animal Communities. CHARLES S. ELTON. Methuen, 1966. 90*s*.

While preoccupied with his Bureau of Animal Population's wartime problems of applied research on rats and mice, Charles Elton still found time to plan an ecological survey based on Oxford University's estate at Wytham Woods. This area, of 3,400 acres, close to the centre of England, has been moderately exploited by man for over a thousand years. Different people in many scientific departments have worked on Wytham Hill and the survey has drawn nearly all its material from some two square miles of land. In this small area 3,800 species are already known and the author thinks it likely that at least 5,000 will be found, i.e., between $\frac{1}{8}$ and $\frac{1}{5}$ of the British fauna, on an area that is only 1/60,000 of the British Isles. This is all the more remarkable in view of the absence of maritime, mountain and large lake faunas near Oxford.

The survey aims to classify and analyse the habitat patterns of rivers, ponds, hedges, fields, woods, rookeries, badger setts, mole casts, ant-hills and so on into small units, to find what communities of animals live in each and how these communities interact, within themselves and with one another. The dream of knowing how animal populations are behaving 'behind the curtain of cover', how they preserve some equilibrium with it and among themselves, has evidently haunted Elton for years and inspired this survey.

Habitats are classified into seven Systems which, for completeness, include everything between low-tide mark of the sea and the uppermost free-living animals in the atmosphere. The Systems are Terrestrial, Aquatic, Aquatic/Terrestrial (or Transition), Subterranean, High Air, Domestic (areas where man dwells and alters the immediate habitat drastically) and General (a diverse series including dead and dying wood, macrofungi, dung, carrion, animal artefacts and others). The Systems are subdivided in various and detailed ways so that any habitat may be formally classified. Apart from the Wytham area, much use of the method of classification has been made by the Nature Conservancy, when making inventories of animal habitats in National Nature Reserves.

The Terrestrial System is dealt with extensively, with grassland, scrub, hedgerow, woodland and methods of recording separately described; and communities on dead and dying wood and other organic matter are detailed. There is an interesting discussion of dispersal and invasions, and the stabilizing effect of habitat interspersion, from which the following deserves quotation: 'There are two dangers that are now being more widely discussed than formerly. The first is that in giving priority to economic productivity, especially in regard to the production of large cash crops from the land, the human environment itself may gradually become dull, unvaried, charmless, and treated like a factory rather than a place to live in. The second is that oversimplified communities contain within themselves flaws of organization that render them vulnerable to invaders of unfamiliar kinds, especially those that have evolved in other continental areas. Just how we are to maintain ecological arrangements that will help to solve this dilemma is not yet certainly known, but there are two things that should be done. One is to maintain the maximum variety of natural and semi-natural habitats and their communities in the landscape, as possible buffers against invasions and unbalance . . . The second thing we can do is to discover how life is organized and the balance maintained in natural deciduous woodland with its associated "furniture" of dying and dead organic resources and their communities, as well as in the seral stages leading up to the full forest'.

H.V.T.

The English Dairy Farmer 1500-1900. G. E. FUSSELL. Frank Cass, 1966. 75*s*.

This is a most interesting book both for the student of agriculture and the layman. Indeed a student of politics would also do well to read it, for the wide researches bring out the most fascinating details of the difficulties which agriculturists have overcome during these four centuries. Some of the situations are not without parallel in the years since 1914.

Separate chapters deal with the cow 'around which all dairy farming must revolve', her feeding and housing; while further sections deal with equipment, butter and cheesemaking, the trade which developed from the manufacture of these

products and the sale of liquid milk.

While Manorial Courts settled how many cows could be put in the 'open field' there was little scope for initiative, yet the Tudor peasant was most dependent on his cow to provide important elements of the daily diet. Up to the time of the Dissolution of the Monasteries, religious houses and hospitals alone seemed to own sizable herds; thereafter landowners and yeoman farmers had larger herds.

In the eighteenth century large scale enclosures and redistribution of the open arable fields made it possible for a farmer to segregate his cows from 'the village herd'. The main distinctions between breeds were in size, colour and shape of horns. Where the Danes had settled there were mainly polled cattle, and where the Anglo-Saxon influence was strongest the cattle were predominantly red.

There was a continuous struggle to provide enough food for the cows, permanent pasturage was often undrained and spread with ant-hills. Arable land and meadows reserved for haymaking received most attention and not until 1700 is it recorded that 'the better the pasturage the better the return'! Much valuable information is given on the development of new grasses and clover, together with the new supplementary crops like lucerne, cabbage, mangels and rape with which there was constant experiment. Bone manure was then considered the most valuable fertilizer and later in the mid-nineteenth century Guano Chilean nitrate and Gypsum were more widely used.

Tudor ancestors paid little heed to the housing for their cattle. Much is written about eighteenth century developments which gave consideration to light, ventilation, drainage and the method of tying the cows. However, the farmhouse dairy was of great importance and the example of the Prince Consort's Frogmore dairy built at the end of the nineteenth century was much quoted.

The details concerning buttermaking and cheesemaking equipment are of tremendous interest and 'half a century of inventions' is discussed. The most fascinating is the chapter showing the methods used to make Cheshire and Cheddar Cheese. The thermometer was the most valued invention, especially to the small farmer who could not afford expensive equipment. The first syphon milking machine was used in 1836, the first milk cooler exhibited in 1872 and the first separator used in 1879. By the mid-eighteenth century dairy farmers had discovered the properties of the fourth stomach of the suckling calf, but it was after much experiment that rennet was extracted by soaking the 'vells'. Bacteriology as a science was unknown, and the dairymaid was often blamed for things quite beyond her control.

The slowness of transport hampered the dairy trade. Canals partly helped to solve the problem, which was further simplified by the building of railways. Large quantities of butter were exported in the early seventeenth century, licences being granted with sometimes a proviso to the effect that no more be exported if the price at home rose above fourpence per pound! However, in the late sixteenth century Friesland cheese and butter was on offer for import.

The establishment of industrial townships and a marked increase in population especially between 1851 and 1901 lead to the establishment of large 'town dairies' and in the very early nineteenth century retail milk sales began. These dairies had difficulty in maintaining the health of their cattle, and increasingly the better handling of milk on the farm; also better transport facilities made the delivery of milk from the country to the town a daily possibility resulting in a decrease in the volume of farm made butter and cheese.

Each chapter in this excellent historical record lists all the books and publications consulted and this is most valuable. There is also a first class bibliography and index.

K.D.M.

Soil and Water Conservation Engineering. (2nd Edition). SCHWAB, FREVERT, EDMINSTER and BARNES. John Wiley and Sons, 1966. £6. 4*s*.

This is an extremely comprehensive book directed towards the American reader, but this should not be allowed to conceal the fact that it contains a great deal of value to others.

The subjects covered include hydrology, soil, water and plant relationships, erosion and its control, earth dams, flood control, drainage and irrigation. The theoretical considerations described in the various chapters are of general application, but the practical examples are almost entirely related to American conditions and many of these are not applicable to this country. Some of the chapters try to be so comprehensive that they necessarily gloss over important details. The reader who wishes to put into practice the methods described in those portions of the book which deal with field problems will, therefore, have to read further and he will be helped to do this by the very long list of references at the end

of each chapter. To apply them to British conditions, however, he will have to supplement this by more appropriate reading.

This is a most useful book which can be recommended to anyone who wishes background information on all aspects of irrigation and drainage, and who is prepared to reject the material which is not relevant to this country and to follow up the further references where necessary. It is profusely illustrated by diagrams and photographs, and arithmetical examples are included to enable the reader to test his 'infiltration rate'.

K.H.L.

Types of Farming in Britain. KEITH BUCHANAN and D. J. SINCLAIR. Association of Agriculture, 1966. 10*s*.

This little booklet, seventeen pages of text with a foreword, eight plates and a map, attempts to describe the principal systems of farming in Britain and to summarize the physical, economic and social factors influencing their geographical distribution. It is a revision of Professor Keith Buchanan's booklet *The Distribution of Systems of Farming in Britain*, published by the Association of Agriculture in 1953.

The authors warn readers that the generalized map (scale approximately 70 miles to the inch) inevitably involves a considerable measure of simplification. The same warning applies equally to the text. Much of this is the same as the original, slightly rearranged and extended. They have attempted to treat the significance of the various factors more explicitly and have added a new section on technical progress. In a work of this brevity generalizations are inevitable and the change in treatment makes the reader more conscious of what has been omitted and of exceptions to what has been said. It also makes the text less easy to read and possibly more confusing to the geography student for whom it seems primarily intended.

The occasional rewording and rearrangement of the original text have not always improved its accuracy. Other parts of the original have been allowed to stand where alteration might well have been justified. There is a considerable discrepancy between the amended map and the unaltered descriptions in the text of the distribution of 'Cropping with Livestock' and 'Cropping' types in East Yorkshire.

The authors refer to areas in terms of their geology without advising readers that a variety of soils can occur on what geological survey maps show as the same formation. It is also a pity that size of farm is not mentioned as a factor directly influencing type of farming.

Despite these reservations the booklet should provide a useful and stimulating basis for further work by students interested in agricultural geography.

J.P.M.

Pruning Apple Trees. C. R. THOMPSON. Faber and Faber, 1966. 42*s*.

The author is an acknowledged authority on pruning having spent the greater part of his life studying various aspects of the subject both from the research and advisory side, and more recently as a manager of a very successful fruit farm. His ideas on renewal pruning have found widespread acceptance and were fully described in his first book on pruning.

The present edition covers the subject from a wider angle and he rightly makes the point that no one pruning system possesses all the merits and that rigidity in approach to pruning may not achieve the best result.

After useful introductory chapters on the principles of pruning and growing methods, the book deals systematically with the early stages of pruning of trees to be developed under the different systems of growing. The following chapters cover the pruning of established trees under these different systems. To some readers it might seem preferable if each system of growing had been dealt with completely in its own section and so made for easier reading.

Pruning has been described as an art but it is often more a matter of anticipating the results of the work and the application of commonsense. To the beginner the description of some of the pruning methods, including the treatment of selected buds, may be an unnecessary complication particularly in view of the increasing costs of labour.

For many growers some of the main problems in pruning occur when relatively closely planted trees become too large or too vigorous for their allotted space. This problem will become of increasing importance with the growing popularity of the so-called hedgerow systems. The last chapter in the book deals with the 'containment' of such trees and suggests a pruning method which will no doubt attract many followers.

The line drawings and photographs are good but reference to particular illustrations mentioned in the text would have been made easier if the page references had been included.

F.A.R.

Exporting British Breeding Stock and Semen. THE ECONOMIST INTELLIGENCE UNIT. Agricultural Market Development Executive Committee, 1966. 15*s.* (including postage).

When there is so much emphasis on exports of all sorts, it is timely that the contribution made by our pedigree animals should be examined. After reviewing the livestock populations of the major countries and the exports achieved by them in relation to the increasing world demand for meat, it is thought that U.K. exports should expand. Three basic requirements are suggested: to make exporting as simple and as attractive as possible to the breeder; to improve all aspects of promotion, education and publicity regarding British stock overseas; and to improve the machinery for transforming inquiries into actual sales. Many factors enter into the implementation of these aims, such as additional finance from the Government, the degree to which it should support and promote exports, better co-ordination between breeders, breed societies, shippers, the Livestock Export Council and the newly instituted Agricultural Export Council.

Such changes are necessary if the U.K. is to obtain its fair share in the old and new markets. Three broad categories are distinguished: (1) countries which have poor standards of livestock and often undernourished population; (2) those whose living standards are rapidly rising and where the main concern is to increase livestock numbers as quickly as possible; (3) countries with livestock populations of good quality and where increased productivity is of greater interest than greater numbers. Traditionally, U.K. exports have been largely centred on the last category—to Eire, U.S.A., Canada—but possibly more scope exists in the second category, with Spain and Italy as examples. These need greater numbers of healthy but lower-priced animals of good commercial type, rather than a few high-priced animals. Thus in 1964 Spain imported nearly 5,000 Friesian in-calf heifers from Canada; they cost about £200 each delivered to a Spanish port. Cost and availability of numbers were the two primary considerations.

This is a thoughtful report and AMDEC is to be congratulated for making a substantial grant towards its cost.

H.E.

Books Received

The Economy of Sheep on East Midland Farms. R. Owen Wood. F.R. No. 164. Department of Agricultural Economics, University of Nottingham, 1967. 5*s.*

An Exercise in Planning. H. W. T. Kerr and H. A. Thomas. F.R. No. 166. Department of Agricultural Economics, University of Nottingham, 1967. 4*s.*

Report on Forest Research 1966. Forestry Commission. H.M. Stationery Office. 12*s.* 6*d.* (by post 13*s.* 2*d.*)

Farm Buildings Surveys Report No. 3. England. R. H. Charlick. National Institute of Agricultural Engineering, Wrest Park, Silsoe, Bedford, 1967. 5*s.*

Financing Agricultural Co-operatives. Maxwell Stamp Associates Ltd. Agricultural Co-operative Assoc. Ltd., 1967.

Some Economic Aspects of Milk Production. A Study in South West England. Betty J. Roscoe and J. A. Langley. Report No. 162. Department of Agricultural Economics, University of Exeter, 1967. 3*s.* 6*d.*

Fruit. (No. 16). A review of production and trade relating to fresh, canned, frozen and dried fruit, fruit juices and wine. 1967. Copies obtainable from The Commonwealth Secretariat, Commodities Division, 10 Carlton House Terrace, London, S.W.1. 40*s.* (by post 41*s.*).

Annual Report of Studies in Animal Nutrition and Allied Sciences. Vol. 22, 1966. Copies from The Librarian, The Rowett Research Institute, Bucksburn, Aberdeen, Scotland. 10*s.* (including postage).

Research Sponsored by the Potato Marketing Board. Report No. 1, 1967. Copies obtainable from the Board.

Smallholdings organised on the basis of Centralised Services. Report and Accounts for the Year 1965-66. Land Settlement Association. H.M. Stationery Office. 3*s.* 6*d.*

Farm Organisation and Incomes in South West England 1965-66. Report No. 165. Department of Agricultural Economics, University of Exeter, 1967. 7*s.* 6*d.*

The Ministry's Publications

Since the list published in the May, 1967, issue of *Agriculture* (p. 234) the following leaflets have been issued.

FIXED EQUIPMENT OF THE FARM LEAFLET

No. 51. Housing the Sow and Litter (New) 2*s*. 3*d*. (by post 2*s*. 6*d*.)

FREE ISSUES

ADVISORY LEAFLETS

No. 299. Brussels sprouts (Revised)

No. 306. Foul Brood (Revised)

No. 460. Stem Eelworm on Narcissi (Revised)
(*formerly Stem and Bulb Eelworm on Narcissi, Hyacinths and Related Bulbs*)

No. 522. Black Grass (Revised)

No. 540. Lighting for Egg Production (Revised)

SHORT TERM LEAFLETS

No. 43. Rolling Barley for Cattle Feeding (Revised)

No. 59. Separate Grazing Management for Twins and Singles (New)

No. 61. Horticultural Management Records (New)

The priced publication listed above is obtainable from Government Bookshops (addresses below), or through any bookseller. Unpriced items are obtainable only from the Ministry (Publications), Tolcarne Drive, Pinner, Middlesex.

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Qualifications and terms. A degree or diploma in Agriculture. Experience in all aspects of the coconut and cocoa growing and processing industries. Salary: £2,500—£3,000 a year, subject to British income tax, plus a variable tax-free overseas allowance currently payable at the rate of £255 (single), £755 (married unaccompanied) or £710 (married accompanied) a year. Contract 2½ years.